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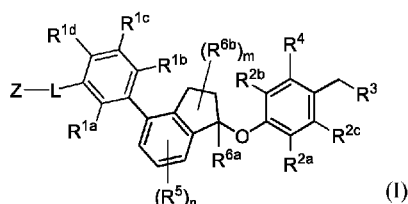
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## (54) Title: IMMUNOMODULATOR COMPOUNDS



(I)

(57) Abstract: Compounds are provided that are useful as immunomodulators. The compounds have the following Formula (I) including stereoisomers and pharmaceutically acceptable salts thereof, wherein Z, L, R<sup>1a</sup>, R<sup>1b</sup>, R<sup>1c</sup>, R<sup>1d</sup>, R<sup>2a</sup>, R<sup>2b</sup>, R<sup>2c</sup>, R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, R<sup>6a</sup>, R<sup>6b</sup>, m and n are as defined herein. Methods associated with preparation and use of such compounds, as well as pharmaceutical compositions comprising such compounds, are also disclosed.



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**IMMUNOMODULATOR COMPOUNDS****CROSS-REFERENCES TO RELATED APPLICATIONS**

[0001] This application claims priority to U.S. Provisional Application Serial No. 62/538,123 filed July 28, 2017, the contents of which is incorporated herein by reference in its entirety.

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**STATEMENT AS TO RIGHTS TO INVENTIONS MADE UNDER  
FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT**

[0002] NOT APPLICABLE

**REFERENCE TO A "SEQUENCE LISTING," A TABLE, OR A COMPUTER  
PROGRAM LISTING APPENDIX SUBMITTED ON A COMPACT DISK**

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[0003] NOT APPLICABLE

**BACKGROUND OF THE DISCLOSURE**

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[0004] Programmed cell death protein -1 (PD-1) is a member of the CD28 superfamily that delivers negative signals upon interaction with its two ligands, PD-L1 or PD-L2. PD-1 and its ligands are broadly expressed and exert a wide range of immunoregulatory roles in T cell activation and tolerance. PD-1 and its ligands are involved in attenuating infectious immunity and tumor immunity, and facilitating chronic infection and tumor progression.

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[0005] Modulation of the PD-1 pathway has therapeutic potential in various human diseases (Hyun-Tak Jin et al., *Curr Top Microbiol Immunol.* (2011); 350:17-37). Blockade of the PD-1 pathway has become an attractive target in cancer therapy. Therapeutic antibodies that block the programmed cell death protein -1 (PD-1) immune checkpoint pathway prevent T-cell down regulation and promote immune responses against cancer. Several PD-1 pathway inhibitors have shown robust activity in various phases of clinical trials (RD Harvey, *Clinical Pharmacology and Therapeutics* (2014); 96(2), 214-223).

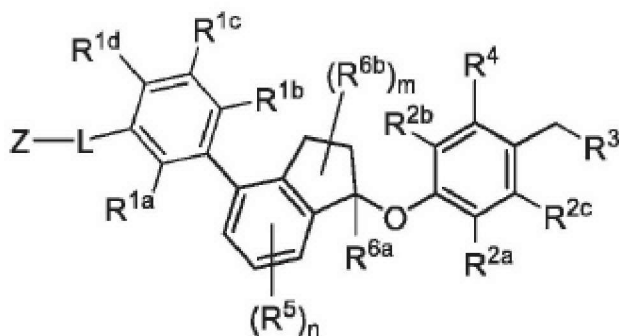
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[0006] Accordingly, agents that block the interaction of PD-L1 with either PD-1 or CD80 are desired. Some antibodies have been developed and commercialized (FDA approved anti-PD-1

antibodies: Pembrolizumab & Nivolumab; FDA approved anti-PD-L1 antibodies: Atezolizumab, Avelumab & Durvalumab). A few patent applications disclosing non-peptidic small molecules have been published (WO 2015/160641, WO 2015/034820, WO 2017/066227, WO 2018/00905, WO 2018/044963, and WO 2018/118848 from BMS; WO 2015/033299, WO 2015/033301, WO 2016/142886, WO 2016/142894, WO 2018/051254, and WO 2018/051255 from Aurigene; WO 2017/070089, US 2017/0145025, WO 2017/106634, US2017/0174679, US 2017/0107216, WO 2017/112730, WO 2017/192961, WO 2017/205464, WO 2017/222976, WO 2018/013789, WO 2018/044783, WO 2018/119221, WO 2018/119224, WO 2018/119236, WO 2018/119263, WO 2018/119266, and WO 2018/119286 from Incyte). However, there is still a need for alternative compounds such as small molecules as inhibitors of PD-L1 which may have advantageous characteristics in term of oral administration, stability, bioavailability, therapeutic index, and/or toxicity.

### BRIEF SUMMARY OF THE DISCLOSURE

[0001] In a first aspect of the invention, there is provided a compound of Formula (I)



(I)

or a pharmaceutically acceptable salt thereof;

wherein:

each of  $R^{1a}$ ,  $R^{1b}$ ,  $R^{1c}$  and  $R^{1d}$  is independently selected from the group consisting of H, halogen,  $CF_3$ , CN,  $C_{1-4}$  alkyl and  $-O-C_{1-4}$  alkyl;

L is a linking group selected from the group consisting of:



wherein each of the subscripts q is independently 1, 2, 3 or 4, and L is optionally further substituted with one or two members selected from the group consisting of halogen, hydroxy, C<sub>1-3</sub> alkyl, -O-C<sub>1-3</sub> alkyl, C<sub>1-3</sub> hydroxyalkyl, C<sub>1-3</sub> haloalkyl and -CO<sub>2</sub>H;

Z is selected from the group consisting of azetidiny, pyrrolidiny, piperidiny, piperaziny, morpholiny, pyridyl, pyrimidiny, imidazolyl, guanidiny, quinuclidine, 2-azaspiro[3.3]heptane and 8-azabicyclo[3.2.1]octane, each of which is optionally substituted with from 1 to 4 groups independently selected from halogen, CN, hydroxy, oxo, C<sub>1-4</sub> alkyl, -NH<sub>2</sub>, -NHC<sub>1-3</sub>alkyl, -N(C<sub>1-3</sub>alkyl)<sub>2</sub>, -O-C<sub>1-3</sub> alkyl, C<sub>1-3</sub> hydroxyalkyl, C<sub>1-3</sub> haloalkyl, -OC(O)(C<sub>1-4</sub> alkyl), -CO<sub>2</sub>(C<sub>1-4</sub> alkyl) and -CO<sub>2</sub>H;

or

Z is -NR<sup>a</sup>R<sup>b</sup>; wherein R<sup>a</sup> is selected from the group consisting of H, C<sub>1-8</sub> alkyl, C<sub>1-8</sub> haloalkyl and C<sub>1-8</sub> hydroxyalkyl; and R<sup>b</sup> is selected from H, -C<sub>1-8</sub> alkyl, and C<sub>1-8</sub> haloalkyl;

R<sup>2b</sup> and R<sup>2c</sup> are both H and R<sup>2a</sup> is halogen;

R<sup>3</sup> is selected from the group consisting of -NR<sup>g</sup>R<sup>h</sup> and C<sub>4-12</sub> heterocyclyl, wherein the C<sub>4-12</sub> heterocyclyl is optionally substituted with 1 to 6 R<sup>3a</sup>;

each R<sup>3a</sup> is independently selected from the group consisting of halogen, -CN,

oxo, -OR<sup>i</sup>, -CO<sub>2</sub> R<sup>j</sup>, -CONR<sup>j</sup> R<sup>k</sup>, -CONHC<sub>1-6</sub> alkyl-OH, -C(O) R<sup>j</sup>, -OC(O) NR<sup>j</sup> R<sup>k</sup>, -NR<sup>j</sup> C(O) R<sup>k</sup>, -NR<sup>j</sup> C(O)<sub>2</sub> R<sup>k</sup>, -CONHOH, -PO<sub>3</sub> H<sub>2</sub>, -NR<sup>j</sup> -X<sup>3</sup> C(O)<sub>2</sub> R<sup>k</sup>, -NR<sup>j</sup> C(O) NR<sup>j</sup> R<sup>k</sup>, -NR<sup>j</sup> R<sup>k</sup>, -OR<sup>j</sup>, -S(O)<sub>2</sub> NR<sup>j</sup> R<sup>k</sup>, -OX<sup>3</sup> -R<sup>j</sup>, -OX<sup>3</sup> -NR<sup>j</sup> R<sup>k</sup>, -O-X<sup>3</sup>-CO<sub>2</sub>R<sup>j</sup>, -O-X<sup>3</sup>-CONR<sup>j</sup>R<sup>k</sup>, -X<sup>3</sup>-OR<sup>j</sup>, -X<sup>3</sup>-NR<sup>j</sup>R<sup>k</sup>, -X<sup>3</sup>-CO<sub>2</sub>R<sup>j</sup>, -X<sup>3</sup>-CONR<sup>j</sup>R<sup>k</sup>, -X<sup>3</sup>-CONHSO<sub>2</sub>R<sup>j</sup> and SF<sub>5</sub>; wherein X<sup>3</sup> is C<sub>1-6</sub> alkylene and is optionally further substituted with OH, SO<sub>2</sub>NH<sub>2</sub>, CONH<sub>2</sub>, C(O)NHOH, PO<sub>3</sub>H<sub>2</sub>, COO-C<sub>1-8</sub>alkyl or CO<sub>2</sub>H, wherein each R<sup>j</sup> and R<sup>k</sup> is independently selected from hydrogen C<sub>1-8</sub> alkyl optionally substituted with 1 to 2 substituents selected from OH, SO<sub>2</sub>NH<sub>2</sub>, CONH<sub>2</sub>, C(O)NHOH, PO<sub>3</sub>H<sub>2</sub>, COO-C<sub>1-8</sub>alkyl or CO<sub>2</sub>H, and C<sub>1-8</sub>haloalkyl optionally substituted with 1 to 2 substituents selected from OH, SO<sub>2</sub>NH<sub>2</sub>, CONH<sub>2</sub>, C(O)NHOH, PO<sub>3</sub>H<sub>2</sub>, COO-C<sub>1-8</sub>alkyl or CO<sub>2</sub>H, or when attached to the same nitrogen atom R<sup>j</sup> and R<sup>k</sup> can be combined with the nitrogen atom to form a five or six-membered ring having from 0 to 2 additional heteroatoms as ring members selected from N, O or S, and optionally substituted with oxo; each R<sup>1</sup> is independently selected from the group consisting of -OH, C<sub>1-8</sub> alkyl, C<sub>2-8</sub> alkenyl, and C<sub>1-8</sub>haloalkyl each of which may be optionally substituted with OH, SO<sub>2</sub>NH<sub>2</sub>, CONH<sub>2</sub>, C(O)NHOH, PO<sub>3</sub>H<sub>2</sub>, COO-C<sub>1-8</sub>alkyl or CO<sub>2</sub>H;

$R^g$  is selected from the group consisting of H,  $C_{1-8}$ haloalkyl and  $C_{1-8}$  alkyl;

$R^h$  is selected from  $-C_{1-8}$ alkyl,  $C_{1-8}$ haloalkyl,  $C_{1-8}$ hydroxyalkyl,  $C_{1-8}$ alkyl- $CO_2R^j$ ,  $C_{1-8}$ alkyl- $CONR^iR^k$ , and  $C_{1-8}$ alkyl- $CONHSO_2R^j$ ,  $C_{1-8}$  alkyl  $-SO_2NR^iR^k$ ,  $C_{1-8}$  alkyl- $SO_3R^j$ ,  $C_{1-8}$  alkyl-  $B(OH)_2$ ,  $C_{1-8}$  alkyl- $PO_3H_2$ ,  $C_{1-8}$  alkyl- $C(O)NHOH$ ,  $C_{1-8}$  alkyl- $NR^{h1}R^{h2}$ ,  $-C(O)R^j$ ,  $C_{3-10}$  cycloalkyl,  $-C_{3-10}$  cycloalkyl- $COOR^j$ ,  $-C_{3-10}$  cycloalkyl- $OR^j$ ,  $C_{4-8}$  heterocyclyl,  $-C_{4-8}$  heterocyclyl- $COOR^j$ ,  $-C_{4-8}$  heterocyclyl  $-OR^j$ ,  $-C_{1-8}$ alkyl- $C_{4-8}$  heterocyclyl,  $-C(=O)OC_{1-8}$  alkyl- $C_{4-8}$  heterocyclyl,  $-C_{1-8}$ alkyl- $C_{3-10}$ cycloalkyl,  $C_{5-10}$  heteroaryl,  $-C_{1-8}$ alkyl- $C_{5-10}$  heteroaryl,  $-C_{1-8}$  alkyl- $C_{6-10}$  aryl,  $-C_{1-8}$  alkyl- $(C=O)-C_{6-10}$  aryl,  $-CO_2-$   $C_{1-8}$  alkyl- $O_2C-C_{1-8}$  alkyl,  $-C_{1-8}$  alkyl- $NH(C=O)-C_{2-8}$  alkenyl,  $-C_{1-8}$  alkyl- $NH(C=O)-C_{1-8}$  alkyl,  $-C_{1-8}$  alkyl-  $NH(C=O)-C_{2-8}$  alkynyl,  $-C_{1-8}$  alkyl  $-(C=O)-NH-$   $C_{1-8}$  alkyl- $COOR^j$ , and  $-C_{1-8}$  alkyl- $(C=O)-NH-C_{1-8}$  alkyl- $OR^j$  optionally substituted with  $CO_2H$ ; or

$R^h$  combined with the N to which it is attached is a mono-, di- or tri-peptide comprising 1-3 natural amino acids and 0-2 non-natural amino acids, wherein

the non-natural aminoacids have an alpha carbon substituent selected from the group consisting of  $C_{2-4}$  hydroxyalkyl,  $C_{1-3}$  alkyl-guanidiny, and  $C_{1-4}$  alkyl-heteroaryl, the alpha carbon of each natural or non-natural amino acids are optionally further substituted with a methyl group, and

the terminal moiety of the mono-, di-, or tri-peptide is selected from the group consisting of  $C(O)OH$ ,  $C(O)O-C_{1-6}$  alkyl, and  $PO_3H_2$ , wherein

$R^{h1}$  and  $R^{h2}$  are each independently selected from the group consisting of H,  $C_{1-6}$  alkyl, and  $C_{1-4}$  hydroxyalkyl;

the  $C_{1-8}$  alkyl portions of  $R^h$  are optionally further substituted with from 1 to 3 substituents independently selected from OH,  $COOH$ ,  $SO_2NH_2$ ,  $CONH_2$ ,  $C(O)NHOH$ ,  $COO-$   $C_{1-8}$  alkyl,  $PO_3H_2$  and  $C_{5-6}$ heteroaryl optionally substituted with 1 to 2  $C_{1-3}$  alkyl substituents,

the  $C_{5-10}$  heteroaryl and the  $C_{6-10}$  aryl portions of  $R^h$  are optionally substituted with 1 to 3 substituents independently selected from OH,  $B(OH)_2$ ,  $COOH$ ,  $SO_2NH_2$ ,  $CONH_2$ ,  $C(O)NHOH$ ,  $PO_3H_2$ ,  $COO-C_{1-8}$ alkyl,  $C_{1-4}$ alkyl,  $C_{1-4}$ alkyl-OH,  $C_{1-4}$ alkyl- $SO_2NH_2$ ,  $C_{1-4}$ alkyl  $CONH_2$ ,  $C_{1-4}$ alkyl- $C(O)NHOH$ ,  $C_{1-4}$ alkyl-  $PO_3H_2$ ,  $C_{1-4}$ alkyl- $COOH$ , and phenyl and the  $C_{4-8}$  heterocyclyl and  $C_{3-10}$  cycloalkyl portions of  $R^h$  are optionally substituted with 1 to 4  $R^w$  substituents;

each  $R^w$  substituent is independently selected from  $C_{1-4}$  alkyl,  $C_{1-4}$  alkyl-OH,  $C_{1-4}$  alkyl-COOH,  $C_{1-4}$  alkyl-SO<sub>2</sub>NH<sub>2</sub>, CM alkyl CONH<sub>2</sub>, CM alkyl-C(O)NHOH,  $C_{1-4}$  alkyl-PO<sub>3</sub>H, OH, COO- $C_{1-8}$  alkyl, COOH, SO<sub>2</sub>NH<sub>2</sub>, CONH<sub>2</sub>, C(O)NHOH, PO<sub>3</sub>H<sub>2</sub> and oxo;

$R^4$  is selected from the group consisting of O- $C_{1-8}$  alkyl, O- $C_{1-8}$  haloalkyl,  $C_{6-10}$  aryl,  $C_{5-10}$  heteroaryl, -O- $C_{1-4}$  alkyl- $C_{4-7}$  heterocycloalkyl, -O- $C_{1-4}$  alkyl- $C_{6-10}$  aryl and -O- $C_{1-4}$  alkyl- $C_{5-10}$  heteroaryl, each of which is optionally substituted with 1 to 5  $R^{4a}$ ;

each  $R^{4a}$  is independently selected from the group consisting of halogen, -CN, - $R^m$ , -CO<sub>2</sub> $R^n$ , -CONR<sup>n</sup>R<sup>p</sup>, -C(O) $R^n$ , -OC(O)NR<sup>n</sup>R<sup>p</sup>, -NR<sup>n</sup>C(O)R<sup>p</sup>, -NR<sup>n</sup>C(O)<sub>2</sub> $R^m$ , -NR<sup>n</sup>-C(O)NR<sup>n</sup>R<sup>p</sup>, -NR<sup>n</sup>R<sup>p</sup>, -OR<sup>n</sup>, -O-X<sup>4</sup>-OR<sup>n</sup>, -O-X<sup>4</sup>-NR<sup>n</sup>R<sup>p</sup>, -O-X<sup>4</sup>-CO<sub>2</sub> $R^n$ , -O-X<sup>4</sup>-CONR<sup>n</sup>R<sup>p</sup>, -X<sup>4</sup>-OR<sup>n</sup>, -X<sup>4</sup>-NR<sup>n</sup>R<sup>p</sup>, -X<sup>4</sup>-CO<sub>2</sub> $R^n$ , -X<sup>4</sup>-CONR<sup>n</sup>R<sup>p</sup>, -SF<sub>5</sub>, -S(O)<sub>2</sub>R<sup>n</sup>R<sup>p</sup>, -S(O)<sub>2</sub>NR<sup>n</sup>R<sup>p</sup>,  $C_{3-7}$  cycloalkyl and  $C_{4-7}$  heterocycloalkyl, wherein the cycloalkyl and heterocycloalkyl rings are optionally substituted with 1 to 5  $R^1$ , wherein each  $R^1$  is independently selected from the group consisting of  $C_{1-8}$  alkyl,  $C_{1-8}$  haloalkyl, -CO<sub>2</sub> $R^n$ , -CONR<sup>n</sup>R<sup>p</sup>, -C(O) $R^n$ , -OC(O)NR<sup>n</sup>R<sup>p</sup>, -NR<sup>n</sup>C(O)R<sup>p</sup>, -NR<sup>n</sup>C(O)<sub>2</sub> $R^m$ , -NR<sup>n</sup>-C(O)NR<sup>n</sup>R<sup>p</sup>, -NR<sup>n</sup>R<sup>p</sup>, -OR<sup>n</sup>, -O-X<sup>4</sup>-OR<sup>n</sup>, -O-X<sup>4</sup>-NR<sup>n</sup>R<sup>p</sup>, -O-X<sup>4</sup>-CO<sub>2</sub> $R^n$ , -O-X<sup>4</sup>-CONR<sup>n</sup>R<sup>p</sup>, -X<sup>4</sup>-OR<sup>n</sup>, -X<sup>4</sup>-NR<sup>n</sup>R<sup>p</sup>, -X<sup>4</sup>-CO<sub>2</sub> $R^n$ , -X<sup>4</sup>-CONR<sup>n</sup>R<sup>p</sup>, -SF<sub>5</sub>, and -S(O)<sub>2</sub>NR<sup>n</sup>R<sup>p</sup>;

wherein each X<sup>4</sup> is a  $C_{1-6}$  alkylene; each  $R^n$  and  $R^p$  is independently selected from hydrogen,  $C_{1-8}$  alkyl, and  $C_{1-8}$  haloalkyl, or when attached to the same nitrogen atom can be combined with the nitrogen atom to form a five or six-membered ring having from 0 to 2 additional heteroatoms as ring members selected from N, O or S, and optionally substituted with oxo; each  $R^m$  is independently selected from the group consisting of  $C_{1-8}$  alkyl,  $C_{2-8}$  alkenyl, and  $C_{1-8}$  haloalkyl; and optionally when two R substituents are on adjacent atoms, they are combined to form a fused five or six-membered carbocyclic or heterocyclic ring optionally substituted with oxo;

n is 0 or 1;

each  $R^5$  is independently selected from the group consisting of halogen,  $C_{1-8}$  alkyl, and  $C_{1-8}$  haloalkyl;

$R^{6a}$  is H;

m is 0 or 1;

each  $R^{6b}$  is F.

**[0002]** In a second aspect of the invention, there is provided pharmaceutical composition comprising a compound according to the first aspect of the invention, or a pharmaceutically acceptable salt thereof, and a pharmaceutically acceptable excipient.

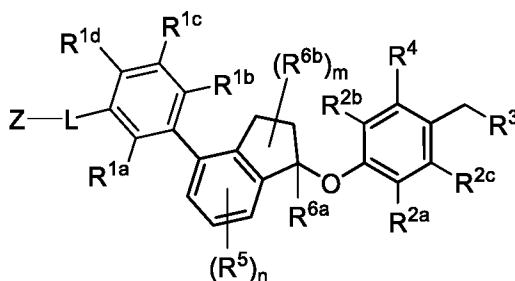
**[0003]** In a third aspect of the invention, there is provided a method of modulating an immune response mediated by the PD-1 signaling pathway in a subject, comprising administering to the subject a therapeutically effective amount of a compound according to the first aspect of the invention, or a pharmaceutically acceptable salt thereof or a composition according to the second aspect of the invention.

**[0004]** In a fourth aspect of the invention, there is provided a method of enhancing, stimulating, modulating and/or increasing the immune response in a subject in need thereof, comprising administering to the subject a therapeutically effective amount of a compound according to the first aspect of the invention, or a pharmaceutically acceptable salt thereof or a composition according to the second aspect of the invention.

**[0005]** In a fifth aspect of the invention, there is provided a method of inhibiting growth, proliferation, or metastasis of cancer cells in a subject in need thereof, comprising administering to the subject a therapeutically effective amount of a compound according to the first aspect of the invention, or a pharmaceutically acceptable salt thereof or a composition according to the second aspect of the invention.

**[0006]** In a sixth aspect of the invention, there is provided a method of treating a subject suffering from or susceptible to a disease or disorder mediated by the PD-1 signaling pathway, comprising administering to the subject a therapeutically effective amount of a compound according to the first aspect of the invention, or a pharmaceutically acceptable salt thereof or a composition according to the second aspect of the invention.

**[0007]** In another aspect, provided herein are compounds having the formula (I):





or a pharmaceutically acceptable salt thereof; wherein  $R^{1a}$ ,  $R^{1b}$ ,  $R^{1c}$ ,  $R^{1d}$ ,  $R^{2a}$ ,  $R^{2b}$ ,  $R^{2c}$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^{6a}$ ,  $R^{6b}$ , m, n, L and Z are as defined herein.

5 **[0008]** In addition to the compounds provided herein, the present disclosure further provides pharmaceutical compositions containing one or more of these compounds, as well as methods associated with preparation and use of such compounds. In some embodiments, the compounds are used in therapeutic methods to treat diseases associated with the PD-1/PD-L1 pathway.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0009] NOT APPLICABLE

**DETAILED DESCRIPTION OF THE DISCLOSURE****Abbreviation and Definitions**

- 5 [0010] The terms “a,” “an,” or “the” as used herein not only include aspects with one member, but also include aspects with more than one member. For instance, the singular forms “a,” “an,” and “the” include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to “a cell” includes a plurality of such cells and reference to “the agent” includes reference to one or more agents known to those skilled in the art, and so forth.
- 10 [0011] The terms “about” and “approximately” shall generally mean an acceptable degree of error for the quantity measured given the nature or precision of the measurements. Typical, exemplary degrees of error are within 20 percent (%), preferably within 10%, and more preferably within 5% of a given value or range of values. Alternatively, and particularly in biological systems, the terms “about” and “approximately” may mean values that are within an
- 15 order of magnitude, preferably within 5-fold and more preferably within 2-fold of a given value. Numerical quantities given herein are approximate unless stated otherwise, meaning that the term “about” or “approximately” can be inferred when not expressly stated.
- [0012] The term “alkyl”, by itself or as part of another substituent, means, unless otherwise stated, a straight or branched chain hydrocarbon group, having the number of carbon atoms
- 20 designated (*i.e.* C<sub>1-8</sub> means one to eight carbons). Examples of alkyl groups include methyl, ethyl, n-propyl, isopropyl, n-butyl, t-butyl, isobutyl, sec-butyl, n-pentyl, n-hexyl, n-heptyl, n-octyl, and the like. The term “alkenyl” refers to an unsaturated alkyl group having one or more double bonds. Similarly, the term “alkynyl” refers to an unsaturated alkyl group having one or more triple bonds. Examples of alkenyl groups include vinyl, 2-propenyl, crotyl, 2-isopentenyl,
- 25 2-(butadienyl), 2,4-pentadienyl and 3-(1,4-pentadienyl). Examples of alkynyl groups include ethynyl, 1- and 3-propynyl, 3-butylnyl, and the higher homologs and isomers. The term “cycloalkyl” refers to hydrocarbon rings having the indicated number of ring atoms (*e.g.*, C<sub>3</sub>-cycloalkyl) and being fully saturated or having no more than one double bond between ring vertices. “Cycloalkyl” is also meant to refer to bicyclic and polycyclic hydrocarbon rings such

as, for example, bicyclo[2.2.1]heptane, bicyclo[2.2.2]octane, etc. The bicyclic or polycyclic rings may be fused, bridged, spiro or a combination thereof. The term "heterocycloalkyl" or "heterocyclyl" refers to a cycloalkyl group that contain from one to five heteroatoms selected from N, O, and S, wherein the nitrogen and sulfur atoms are optionally oxidized, and the nitrogen atom(s) are optionally quaternized. The heterocycloalkyl may be a monocyclic, a bicyclic or a polycyclic ring system. The bicyclic or polycyclic rings may be fused, bridged, spiro or a combination thereof. It is understood that the recitation for C<sub>4-12</sub> heterocyclyl, refers to a group having from 4 to 12 ring members where at least one of the ring members is a heteroatom. Non limiting examples of heterocycloalkyl groups include pyrrolidine, imidazolidine, pyrazolidine, butyrolactam, valerolactam, imidazolidinone, tetrazolone, hydantoin, dioxolane, phthalimide, piperidine, 1,4-dioxane, morpholine, thiomorpholine, thiomorpholine-S-oxide, thiomorpholine-S,S-oxide, piperazine, pyran, pyridone, 3-pyrroline, thiopyran, pyrone, tetrahydrofuran, tetrhydrothiophene, quinuclidine, and the like. A heterocycloalkyl group can be attached to the remainder of the molecule through a ring carbon or a heteroatom.

**[0013]** The term "alkylene" by itself or as part of another substituent means a divalent group derived from an alkane, as exemplified by -CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>-. Typically, an alkyl (or alkylene) group will have from 1 to 12 carbon atoms, with those groups having 8 or fewer carbon atoms being preferred in the present disclosure. Similarly, "alkenylene" and "alkynylene" refer to the unsaturated forms of "alkylene" having double or triple bonds, respectively.

**[0014]** The term "heteroalkyl," by itself or in combination with another term, means, unless otherwise stated, a stable straight or branched chain, or cyclic hydrocarbon group, or combinations thereof, consisting of the stated number of carbon atoms and from one to three heteroatoms selected from the group consisting of O, N, Si and S, and wherein the nitrogen and sulfur atoms may optionally be oxidized and the nitrogen heteroatom may optionally be quaternized. The heteroatom(s) O, N and S may be placed at any interior position of the heteroalkyl group. The heteroatom Si may be placed at any position of the heteroalkyl group, including the position at which the alkyl group is attached to the remainder of the molecule. Examples include -CH<sub>2</sub>-CH<sub>2</sub>-O-CH<sub>3</sub>, -CH<sub>2</sub>-CH<sub>2</sub>-NH-CH<sub>3</sub>, -CH<sub>2</sub>-CH<sub>2</sub>-N(CH<sub>3</sub>)-CH<sub>3</sub>, -CH<sub>2</sub>-S-CH<sub>2</sub>-CH<sub>3</sub>, -CH<sub>2</sub>-CH<sub>2</sub>-S(O)-CH<sub>3</sub>, -CH<sub>2</sub>-CH<sub>2</sub>-S(O)<sub>2</sub>-CH<sub>3</sub>, -CH=CH-O-CH<sub>3</sub>, -Si(CH<sub>3</sub>)<sub>3</sub>, -CH<sub>2</sub>-CH=N-OCH<sub>3</sub>, and -CH=CH-N(CH<sub>3</sub>)-CH<sub>3</sub>. Up to two heteroatoms may be consecutive, such as, for

example,  $-\text{CH}_2\text{-NH-OCH}_3$  and  $-\text{CH}_2\text{-O-Si(CH}_3)_3$ . Similarly, the terms “heteroalkenyl” and “heteroalkynyl” by itself or in combination with another term, means, unless otherwise stated, an alkenyl group or alkynyl group, respectively, that contains the stated number of carbons and having from one to three heteroatoms selected from the group consisting of O, N, Si and S, and wherein the nitrogen and sulfur atoms may optionally be oxidized and the nitrogen heteroatom may optionally be quaternized. The heteroatom(s) O, N and S may be placed at any interior position of the heteroalkyl group.

[0015] The term “heteroalkylene” by itself or as part of another substituent means a divalent group, saturated or unsaturated or polyunsaturated, derived from heteroalkyl, as exemplified by  $-\text{CH}_2\text{-CH}_2\text{-S-CH}_2\text{CH}_2\text{-}$  and  $-\text{CH}_2\text{-S-CH}_2\text{-CH}_2\text{-NH-CH}_2\text{-}$ ,  $-\text{O-CH}_2\text{-CH=CH-}$ ,  $-\text{CH}_2\text{-CH=C(H)CH}_2\text{-O-CH}_2\text{-}$  and  $-\text{S-CH}_2\text{-C}\equiv\text{C-}$ . For heteroalkylene groups, heteroatoms can also occupy either or both of the chain termini (e.g., alkyleneoxy, alkylenedioxy, alkyleneamino, alkylenediamino, and the like).

[0016] The terms “alkoxy,” “alkylamino” and “alkylthio” (or thioalkoxy) are used in their conventional sense, and refer to those alkyl groups attached to the remainder of the molecule via an oxygen atom, an amino group, or a sulfur atom, respectively. Additionally, for dialkylamino groups, the alkyl portions can be the same or different and can also be combined to form a 3-7 membered ring with the nitrogen atom to which each is attached. Accordingly, a group represented as  $-\text{NR}^a\text{R}^b$  is meant to include piperidiny, pyrrolidiny, morpholiny, azetidiny and the like.

[0017] The terms “halo” or “halogen,” by themselves or as part of another substituent, mean, unless otherwise stated, a fluorine, chlorine, bromine, or iodine atom. Additionally, terms such as “haloalkyl,” are meant to include monohaloalkyl and polyhaloalkyl. For example, the term “ $\text{C}_{1-4}$  haloalkyl” is meant to include trifluoromethyl, 2,2,2-trifluoroethyl, 4-chlorobutyl, 3-bromopropyl, and the like.

[0018] The term “hydroxyalkyl” or “alkyl-OH” refers to an alkyl group, as defined above, where at least one (and up to three) of the hydrogen atoms is replaced with a hydroxy group. As for the alkyl group, hydroxyalkyl groups can have any suitable number of carbon atoms, such as  $\text{C}_{1-6}$ . Exemplary hydroxyalkyl groups include, but are not limited to, hydroxymethyl,

hydroxyethyl (where the hydroxy is in the 1- or 2-position), hydroxypropyl (where the hydroxy is in the 1-, 2- or 3-position), and 2,3-dihydroxypropyl.

[0019] The term “C<sub>1-3</sub> alkyl-guanidiny” refers to a C<sub>1-3</sub> alkyl group, as defined above, where at least one of the hydrogen atoms is replaced with a guanidiny group ( -NHC(NH)NH<sub>2</sub> ).

5 [0020] The term "aryl" means, unless otherwise stated, a polyunsaturated, typically aromatic, hydrocarbon group which can be a single ring or multiple rings (up to three rings) which are fused together or linked covalently. The term "heteroaryl" refers to aryl groups (or rings) that contain from one to five heteroatoms selected from N, O, and S, wherein the nitrogen and sulfur atoms are optionally oxidized, and the nitrogen atom(s) are optionally quaternized. A heteroaryl  
10 group can be attached to the remainder of the molecule through a heteroatom. It is understood that the recitation for C<sub>5-10</sub> heteroaryl, refers to a heteroaryl moiety having from 5 to 10 ring members where at least one of the ring members is a heteroatom. Non-limiting examples of aryl groups include phenyl, naphthyl and biphenyl, while non-limiting examples of heteroaryl groups include pyridyl, pyridazinyl, pyrazinyl, pyrimidinyl, triazinyl, quinoliny, quinoxaliny,  
15 quinazolinyl, cinnoliny, phthalazinyl, benzotriazinyl, purinyl, benzimidazolyl, benzopyrazolyl, benzotriazolyl, benzisoxazolyl, isobenzofuryl, isoindolyl, indoliziny, benzotriazinyl, thienopyridinyl, thienopyrimidinyl, pyrazolopyrimidinyl, imidazopyridines, benzothiazolyl, benzofuranyl, benzothienyl, indolyl, quinolyl, isoquinolyl, isothiazolyl, pyrazolyl, indazolyl, pteridinyl, imidazolyl, triazolyl, tetrazolyl, oxazolyl, isoxazolyl, thiadiazolyl, pyrrolyl, thiazolyl,  
20 furyl, thienyl and the like. Substituents for each of the above noted aryl and heteroaryl ring systems are selected from the group of acceptable substituents described below.

[0021] The term “carbocyclic ring,” “carbocyclic” or “carbocycl” refers to cyclic moieties with only carbon atoms as ring vertices. Carbocyclic ring moieties are saturated or unsaturated and can be aromatic. Generally, carbocyclic moieties have from 3 to 10 ring members.

25 Carbocyclic moieties with multiple ring structure (e.g. bicyclic) can include a cycloalkyl ring fused to an aromatic ring (e.g. 1,2,3,4-tetrahydronaphthalene). Thus, carbocyclic rings include cyclopentyl, cyclohexenyl, naphthyl, and 1,2,3,4-tetrahydronaphthyl. The term “heterocyclic ring” refers to both “heterocycloalkyl” and “heteroaryl” moieties. Thus, heterocyclic rings are

saturated or unsaturated and can be aromatic. Generally, heterocyclic rings are 4 to 10 ring members and include piperidinyl, tetrazinyl, pyrazolyl and indolyl.

[0022] When any of the above terms (*e.g.*, "alkyl," "aryl" and "heteroaryl") are referred to as 'substituted' without further notation on the substituents, the substituted forms of the indicated group will be as provided below.

[0023] Substituents for the alkyl groups (including those groups often referred to as alkylene, alkenyl, alkynyl and cycloalkyl) can be a variety of groups selected from: -halogen, -OR', -NR'R'', -SR', -SiR'R''R''', -OC(O)R', -C(O)R', -CO<sub>2</sub>R', -CONR'R'', -OC(O)NR'R'', -NR''C(O)R', -NR'-C(O)NR''R''', -NR''C(O)<sub>2</sub>R', -NH-C(NH<sub>2</sub>)=NH, -NR'C(NH<sub>2</sub>)=NH, -NH-C(NH<sub>2</sub>)=NR', -S(O)R', -S(O)<sub>2</sub>R', -S(O)<sub>2</sub>NR'R'', -NR'S(O)<sub>2</sub>R'', -CN and -NO<sub>2</sub> in a number ranging from zero to (2 m' + 1), where m' is the total number of carbon atoms in such group. R', R'' and R''' each independently refer to hydrogen, unsubstituted C<sub>1-8</sub> alkyl, unsubstituted heteroalkyl, unsubstituted aryl, aryl substituted with 1-3 halogens, unsubstituted C<sub>1-8</sub> alkyl, C<sub>1-8</sub> alkoxy or C<sub>1-8</sub> thioalkoxy groups, or unsubstituted aryl-C<sub>1-4</sub> alkyl groups. When R' and R'' are attached to the same nitrogen atom, they can be combined with the nitrogen atom to form a 3-, 4-, 5-, 6-, or 7-membered ring. For example, -NR'R'' is meant to include 1-pyrrolidinyl and 4-morpholinyl. The term "acyl" as used by itself or as part of another group refers to an alkyl group wherein two substituents on the carbon that is closest to the point of attachment for the group is replaced with the substituent =O (*e.g.*, -C(O)CH<sub>3</sub>, -C(O)CH<sub>2</sub>CH<sub>2</sub>OR' and the like).

[0024] Similarly, substituents for the aryl and heteroaryl groups are varied and are generally selected from: -halogen, -OR', -OC(O)R', -NR'R'', -SR', -R', -CN, -NO<sub>2</sub>, -CO<sub>2</sub>R', -CONR'R'', -C(O)R', -OC(O)NR'R'', -NR''C(O)R', -NR''C(O)<sub>2</sub>R', -NR'-C(O)NR''R''', -NH-C(NH<sub>2</sub>)=NH, -NR'C(NH<sub>2</sub>)=NH, -NH-C(NH<sub>2</sub>)=NR', -S(O)R', -S(O)<sub>2</sub>R', -S(O)<sub>2</sub>NR'R'', -NR'S(O)<sub>2</sub>R'', -N<sub>3</sub>, perfluoro(C<sub>1-4</sub>)alkoxy, and perfluoro(C<sub>1-4</sub>)alkyl, in a number ranging from zero to the total number of open valences on the aromatic ring system; and where R', R'' and R''' are independently selected from hydrogen, C<sub>1-8</sub> alkyl, C<sub>3-6</sub> cycloalkyl, C<sub>2-8</sub> alkenyl, C<sub>2-8</sub> alkynyl, unsubstituted aryl and heteroaryl, (unsubstituted aryl)-C<sub>1-4</sub> alkyl, and unsubstituted aryloxy-C<sub>1-4</sub> alkyl. Other suitable substituents include each of the above aryl substituents attached to a ring atom by an alkylene tether of from 1-4 carbon atoms.

[0025] Two of the substituents on adjacent atoms of the aryl or heteroaryl ring may optionally be replaced with a substituent of the formula  $-T-C(O)-(CH_2)_q-U-$ , wherein T and U are independently  $-NH-$ ,  $-O-$ ,  $-CH_2-$  or a single bond, and q is an integer of from 0 to 2.

Alternatively, two of the substituents on adjacent atoms of the aryl or heteroaryl ring may

- 5 optionally be replaced with a substituent of the formula  $-A-(CH_2)_r-B-$ , wherein A and B are independently  $-CH_2-$ ,  $-O-$ ,  $-NH-$ ,  $-S-$ ,  $-S(O)-$ ,  $-S(O)_2-$ ,  $-S(O)_2NR'-$  or a single bond, and r is an integer of from 1 to 3. One of the single bonds of the new ring so formed may optionally be replaced with a double bond. Alternatively, two of the substituents on adjacent atoms of the aryl or heteroaryl ring may optionally be replaced with a substituent of the formula
- 10  $-(CH_2)_s-X-(CH_2)_t-$ , where s and t are independently integers of from 0 to 3, and X is  $-O-$ ,  $-NR'-$ ,  $-S-$ ,  $-S(O)-$ ,  $-S(O)_2-$ , or  $-S(O)_2NR'-$ . The substituent R' in  $-NR'-$  and  $-S(O)_2NR'-$  is selected from hydrogen or unsubstituted  $C_{1-6}$  alkyl.

[0026] As used herein, the term "heteroatom" is meant to include oxygen (O), nitrogen (N), sulfur (S) and silicon (Si).

- 15 [0027] The disclosure herein further relates to prodrugs and bioisosteres thereof. Suitable bioisosteres, for example, will include carboxylate replacements (phosphonic acids, phosphinic acids, sulfonic acids, sulfinic acids, and acidic heterocyclic groups such as tetrazoles). Suitable prodrugs will include those conventional groups known to hydrolyze and/or oxidize under physiological conditions to provide a compound of Formula I.

- 20 [0028] The terms "patient" and "subject" include primates (especially humans), domesticated companion animals (such as dogs, cats, horses, and the like) and livestock (such as cattle, pigs, sheep, and the like).

- [0029] As used herein, the term "treating" or "treatment" encompasses both disease-modifying treatment and symptomatic treatment, either of which may be prophylactic (*i.e.*, before the onset
- 25 of symptoms, in order to prevent, delay or reduce the severity of symptoms) or therapeutic (*i.e.*, after the onset of symptoms, in order to reduce the severity and/or duration of symptoms).

[0030] The term "pharmaceutically acceptable salts" is meant to include salts of the active compounds which are prepared with relatively nontoxic acids or bases, depending on the particular substituents found on the compounds described herein. When compounds of the

present disclosure contain relatively acidic functionalities, base addition salts can be obtained by contacting the neutral form of such compounds with a sufficient amount of the desired base, either neat or in a suitable inert solvent. Examples of salts derived from pharmaceutically-acceptable inorganic bases include aluminum, ammonium, calcium, copper, ferric, ferrous, lithium, magnesium, manganic, manganous, potassium, sodium, zinc and the like. Salts derived from pharmaceutically-acceptable organic bases include salts of primary, secondary and tertiary amines, including substituted amines, cyclic amines, naturally-occurring amines and the like, such as **arginine, betaine, caffeine, choline, N,N'-dibenzylethylenediamine, diethylamine, 2-diethylaminoethanol, 2-dimethylaminoethanol, ethanolamine, ethylenediamine, N-ethylmorpholine, N-ethylpiperidine, glucamine, glucosamine, histidine, hydrabamine, isopropylamine, lysine, methylglucamine, morpholine, piperazine, piperadine, polyamine resins, procaine, purines, theobromine, triethylamine, trimethylamine, tripropylamine, tromethamine** and the like. When compounds of the present disclosure contain relatively basic functionalities, acid addition salts can be obtained by contacting the neutral form of such compounds with a sufficient amount of the desired acid, either neat or in a suitable inert solvent. Examples of pharmaceutically acceptable acid addition salts include those derived from inorganic acids like hydrochloric, hydrobromic, nitric, carbonic, monohydrogencarbonic, phosphoric, monohydrogenphosphoric, dihydrogenphosphoric, sulfuric, monohydrogensulfuric, hydriodic, or phosphorous acids and the like, as well as the salts derived from relatively nontoxic organic acids like acetic, propionic, isobutyric, malonic, benzoic, succinic, suberic, fumaric, mandelic, phthalic, benzenesulfonic, p-tolylsulfonic, citric, tartaric, methanesulfonic, and the like. Also included are salts of amino acids such as arginate and the like, and salts of organic acids like glucuronic or galactunoric acids and the like (see, for example, Berge, S.M., et al, **"Pharmaceutical Salts"**, *Journal of Pharmaceutical Science*, **1977**, 66, 1-19). Certain specific compounds of the present disclosure contain both basic and acidic functionalities that allow the compounds to be converted into either base or acid addition salts.

**[0031]** The neutral forms of the compounds may be regenerated by contacting the salt with a base or acid and isolating the parent compound in the conventional manner. The parent form of the compound differs from the various salt forms in certain physical properties, such as solubility



in polar solvents, but otherwise the salts are equivalent to the parent form of the compound for the purposes of the present disclosure.

[0032] Certain compounds of the present disclosure can exist in unsolvated forms as well as solvated forms, including hydrated forms. In general, the solvated forms are equivalent to unsolvated forms and are intended to be encompassed within the scope of the present disclosure. Certain compounds of the present disclosure may exist in multiple crystalline or amorphous forms. In general, all physical forms are equivalent for the uses contemplated by the present disclosure and are intended to be within the scope of the present disclosure.

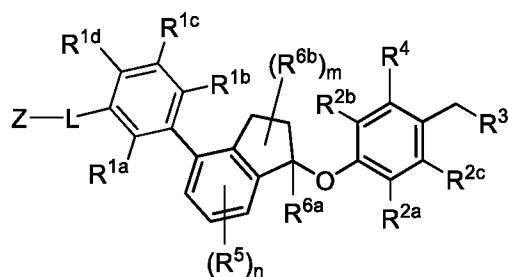
[0033] Certain compounds of the present invention possess asymmetric carbon atoms (optical centers) or double bonds; the racemates, diastereomers, geometric isomers, regioisomers and individual isomers (e.g., separate enantiomers) are all intended to be encompassed within the scope of the present invention. When a stereochemical depiction is shown, it is meant to refer to the compound in which one of the isomers is present and substantially free of the other isomer. **‘Substantially free of’ another isomer indicates** at least an 80/20 ratio of the two isomers, more preferably 90/10, or 95/5 or more. In some embodiments, one of the isomers will be present in an amount of at least 99%.

[0034] The compounds of the present disclosure may also contain unnatural proportions of atomic isotopes at one or more of the atoms that constitute such compounds. For example, the compounds may be radiolabeled with radioactive isotopes, such as for example tritium ( $^3\text{H}$ ), iodine-125 ( $^{125}\text{I}$ ) or carbon-14 ( $^{14}\text{C}$ ). All isotopic variations of the compounds of the present disclosure, whether radioactive or not, are intended to be encompassed within the scope of the present disclosure. For example, the compounds may be prepared such that any number of hydrogen atoms are replaced with a deuterium ( $^2\text{H}$ ) isotope. The compounds of the present disclosure may also contain unnatural proportions of atomic isotopes at one or more of the atoms that constitute such compounds. Unnatural proportions of an isotope may be defined as ranging from the amount found in nature to an amount consisting of 100% of the atom in question. For example, the compounds may incorporate radioactive isotopes, such as for example tritium ( $^3\text{H}$ ), iodine-125 ( $^{125}\text{I}$ ) or carbon-14 ( $^{14}\text{C}$ ), or non-radioactive isotopes, such as deuterium ( $^2\text{H}$ ) or carbon-13 ( $^{13}\text{C}$ ). Such isotopic variations can provide additional utilities to those described

elsewhere within this application. For instance, isotopic variants of the compounds of the disclosure may find additional utility, including but not limited to, as diagnostic and/or imaging reagents, or as cytotoxic/radiotoxic therapeutic agents. Additionally, isotopic variants of the compounds of the disclosure can have altered pharmacokinetic and pharmacodynamic characteristics which can contribute to enhanced safety, tolerability or efficacy during treatment. All isotopic variations of the compounds of the present disclosure, whether radioactive or not, are intended to be encompassed within the scope of the present disclosure.

## COMPOUNDS

[0035] In one aspect, the present disclosure provides compounds having the formula (I)



(I)

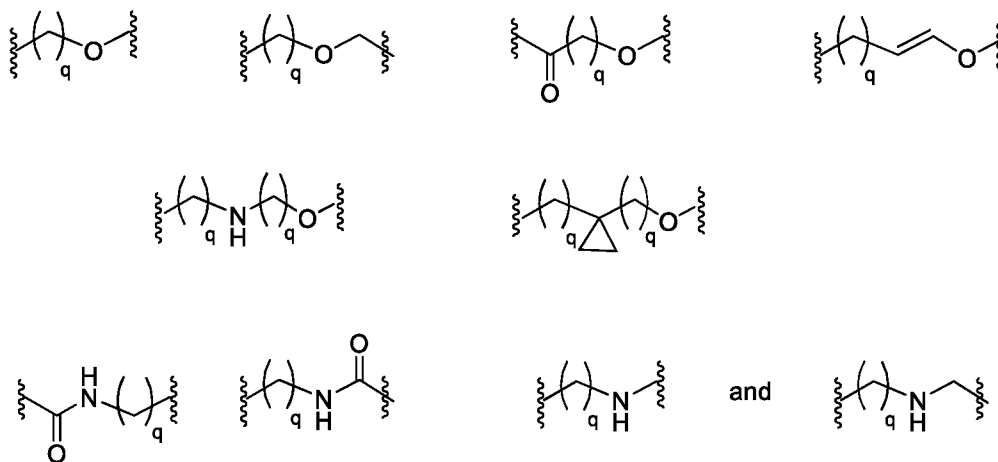
or a pharmaceutically acceptable salt thereof, or a prodrug or bioisostere thereof; wherein:

each of R<sup>1a</sup>, R<sup>1b</sup>, R<sup>1c</sup> and R<sup>1d</sup> is independently selected from the group consisting of H,

halogen, CF<sub>3</sub>, CN, C<sub>1-4</sub> alkyl and -O-C<sub>1-4</sub> alkyl, wherein the C<sub>1-4</sub> alkyl and -O-C<sub>1-4</sub>

alkyl are optionally further substituted with halogen, hydroxyl, methoxy or ethoxy;

L is a linking group selected from the group consisting of:



wherein each of the subscripts  $q$  is independently 1, 2, 3 or 4, and  $L$  is optionally further substituted with one or two members selected from the group consisting of halogen, hydroxy,  $C_{1-3}$  alkyl,  $-O-C_{1-3}$  alkyl,  $C_{1-3}$  hydroxyalkyl,  $C_{1-3}$  haloalkyl and  $-CO_2H$ ;

- 5  $Z$  is selected from the group consisting of azetidiny, pyrrolidiny, piperidiny, morpholiny, pyridyl, pyrimidiny, guanidiny, quinuclidine, and 8-azabicyclo[3.2.1]octane, each of which is optionally substituted with from 1 to 3 groups independently selected from halogen, hydroxy,  $C_{1-3}$  alkyl,  $-NH_2$ ,  $-NHC_{1-3}alkyl$ ,  $-N(C_{1-3}alkyl)_2$ ,  $-O-C_{1-3}$  alkyl,  $C_{1-3}$  hydroxyalkyl,  $C_{1-3}$  haloalkyl and  $-CO_2H$ ;

10 or

$Z$  is selected from the group consisting of  $-CO_2R^a$  and  $-NR^aR^b$ ; wherein  $R^a$  is selected from the group consisting of H,  $C_{1-8}$  alkyl,  $C_{1-8}$  haloalkyl and  $C_{1-8}$  hydroxyalkyl; and  $R^b$  is selected from  $-C_{1-8}$  alkyl,  $C_{1-8}$  haloalkyl,  $C_{1-8}$  alkyl- $COOH$ ,  $C_{1-8}$  alkyl- $OH$ ,  $C_{1-8}$  alkyl- $CONH_2$ ,  $C_{1-8}$  alkyl- $SO_2NH_2$ ,  $C_{1-8}$  alkyl- $PO_3H_2$ ,  $C_{1-8}$  alkyl- $C(O)NHOH$ ,  $-C(O)-C_{1-8}alkyl-OH$ ,  $-C(O)-C_{1-8}alkyl-COOH$ ,  $C_{3-10}$  cycloalkyl,  $-C_{3-10}$  cycloalkyl- $COOH$ ,  $-C_{3-10}$  cycloalkyl- $OH$ ,  $C_{4-8}$  heterocyclyl,  $-C_{4-8}$  heterocyclyl- $COOH$ ,  $-C_{4-8}$  heterocyclyl- $OH$ ,  $-C_{1-8}$  alkyl- $C_{4-8}$  heterocyclyl,  $-C_{1-8}$  alkyl- $C_{3-10}$  cycloalkyl,  $C_{5-10}$  heteroaryl and  $-C_{1-8}alkyl-C_{5-10}$  heteroaryl;

15

each  $R^{2a}$ ,  $R^{2b}$  and  $R^{2c}$  is independently selected from the group consisting of H, halogen,  $-CN$ ,  $-R^d$ ,  $-CO_2R^e$ ,  $-CONR^eR^f$ ,  $-OC(O)NR^eR^f$ ,  $-NR^fC(O)R^e$ ,  $-NR^fC(O)_2R^d$ ,  $-NR^e-C(O)NR^eR^f$ ,  $-NR^eR^f$ ,  $-OR^e$ ,  $-X^2-OR^e$ ,  $-X^2-NR^eR^f$ ,  $-X^2-CO_2R^e$ ,  $-SF_5$ , and  $-S(O)_2NR^eR^f$ , wherein each  $X^2$  is a  $C_{1-4}$  alkylene; each  $R^e$  and  $R^f$  is independently selected from hydrogen,  $C_{1-8}$  alkyl, and  $C_{1-8}$  haloalkyl, or when attached to the same nitrogen atom can be combined with the

20

nitrogen atom to form a five or six-membered ring having from 0 to 2 additional heteroatoms as ring members selected from N, O and S, and optionally substituted with oxo; each  $R^d$  is independently selected from the group consisting of  $C_{1-8}$  alkyl,  $C_{2-8}$  alkenyl, and  $C_{1-8}$  haloalkyl;

- 5  $R^3$  is selected from the group consisting of  $-NR^gR^h$  and  $C_{4-12}$  heterocyclyl, wherein the  $C_{4-12}$  heterocyclyl is optionally substituted with 1 to 6  $R^{3a}$ ;

each  $R^{3a}$  is independently selected from the group consisting of

- halogen,  $-CN$ ,  $-R^i$ ,  $-CO_2R^j$ ,  $-CONR^jR^k$ ,  $-CONHC_{1-6}$  alkyl-OH,  $-C(O)R^j$ ,  $-OC(O)NR^jR^k$ ,  
 10  $-NR^jC(O)R^k$ ,  $-NR^jC(O)_2R^k$ ,  $-CONHOH$ ,  $PO_3H_2$ ,  $-NR^j-X^3-C(O)_2R^k$ ,  
 $-NR^jC(O)NR^jR^k$ ,  $-NR^jR^k$ ,  $-OR^j$ ,  $-S(O)_2NR^jR^k$ ,  $-O-X^3-OR^j$ ,  $-O-X^3-NR^jR^k$ ,  
 $-O-X^3-CO_2R^j$ ,  $-O-X^3-CONR^jR^k$ ,  $-X^3-OR^j$ ,  $-X^3-NR^jR^k$ ,  $-X^3-CO_2R^j$ ,  $-X^3-CONR^jR^k$ , and  
 $SF_5$ ; wherein  $X^3$  is  $C_{1-6}$  alkylene and is optionally further substituted with OH,  $SO_2NH_2$ ,  
 $CONH_2$ ,  $C(O)NHOH$ ,  $PO_3H_2$ ,  $COO-C_{1-8}$  alkyl or  $CO_2H$ , wherein each  $R^j$  and  $R^k$  is  
 15 independently selected from hydrogen,  $C_{1-8}$  alkyl optionally substituted with 1 to 2  
 substituents selected from OH,  $SO_2NH_2$ ,  $CONH_2$ ,  $C(O)NHOH$ ,  $PO_3H_2$ ,  $COO-C_{1-8}$  alkyl or  
 $CO_2H$ , and  $C_{1-8}$  haloalkyl optionally substituted with 1 to 2 substituents selected from  
 OH,  $SO_2NH_2$ ,  $CONH_2$ ,  $C(O)NHOH$ ,  $PO_3H_2$ ,  $COO-C_{1-8}$  alkyl or  $CO_2H$ , or when attached  
 20 to the same nitrogen atom  $R^j$  and  $R^k$  can be combined with the nitrogen atom to form a  
 five or six-membered ring having from 0 to 2 additional heteroatoms as ring members  
 selected from N, O or S, and optionally substituted with oxo; each  $R^i$  is independently  
 selected from the group consisting of  $-OH$ ,  $C_{1-8}$  alkyl,  $C_{2-8}$  alkenyl, and  $C_{1-8}$  haloalkyl  
 each of which may be optionally substituted with OH,  $SO_2NH_2$ ,  $CONH_2$ ,  $C(O)NHOH$ ,  
 $PO_3H_2$ ,  $COO-C_{1-8}$  alkyl or  $CO_2H$ ;

$R^g$  is selected from the group consisting of H,  $C_{1-8}$  haloalkyl and  $C_{1-8}$  alkyl;

- 25  $R^h$  is selected from  $-C_{1-8}$  alkyl,  $C_{1-8}$  haloalkyl,  $C_{1-8}$  hydroxyalkyl,  $C_{1-8}$  alkyl- $CO_2R^j$ ,  $C_{1-8}$  alkyl-  
 $CONR^jR^k$ , and  $C_{1-8}$  alkyl- $CONHSO_2R^j$ ,  $C_{1-8}$  alkyl- $SO_2NR^jR^k$ ,  $C_{1-8}$  alkyl- $PO_3H_2$ ,  $C_{1-8}$  alkyl-  
 $C(O)NHOH$ ,  $C_{1-8}$  alkyl- $NR^{h1}R^{h2}$ ,  $-C(O)R^j$ ,  $C_{3-10}$  cycloalkyl,  $-C_{3-10}$  cycloalkyl- $COOR^j$ ,  $-C_{3-10}$   
 10 cycloalkyl- $OR^j$ ,  $C_{4-8}$  heterocyclyl,  $-C_{4-8}$  heterocyclyl- $COOR^j$ ,  $-C_{4-8}$  heterocyclyl- $OR^j$ , -  
 $C_{1-8}$  alkyl- $C_{4-8}$  heterocyclyl,  $-C(=O)OC_{1-8}$  alkyl- $C_{4-8}$  heterocyclyl,  $-C_{1-8}$  alkyl- $C_{3-10}$   
 30 cycloalkyl,  $C_{5-10}$  heteroaryl,  $-C_{1-8}$  alkyl- $C_{5-10}$  heteroaryl,  $-C_{1-8}$  alkyl- $C_{6-10}$  aryl,  $-C_{1-8}$  alkyl-  
 $(C=O)-C_{6-10}$  aryl,  $-CO_2-C_{1-8}$  alkyl- $O_2C-C_{1-8}$  alkyl,  $-C_{1-8}$  alkyl- $NH(C=O)-C_{2-8}$  alkenyl,  $-C_{1-8}$

alkyl-NH(C=O)-C<sub>1-8</sub> alkyl, -C<sub>1-8</sub> alkyl-NH(C=O)-C<sub>2-8</sub> alkynyl, -C<sub>1-8</sub> alkyl-(C=O)-NH-C<sub>1-8</sub> alkyl-COOR<sup>i</sup>, and -C<sub>1-8</sub> alkyl-(C=O)-NH-C<sub>1-8</sub> alkyl-OR<sup>j</sup> optionally substituted with CO<sub>2</sub>H; or

R<sup>h</sup> combined with the N to which it is attached is a mono-, di- or tri-peptide comprising 1-3 natural amino acids and 0-2 non-natural amino acids, wherein the non-natural amino acids have an alpha carbon substituent selected from the group consisting of C<sub>2-4</sub> hydroxyalkyl, C<sub>1-3</sub> alkyl-guanidiny, and C<sub>1-4</sub> alkyl-heteroaryl, the alpha carbon of each natural or non-natural amino acids are optionally further substituted with a methyl group, and

the terminal moiety of the mono-, di-, or tri-peptide is selected from the group consisting of C(O)OH, C(O)O-C<sub>1-6</sub> alkyl, and PO<sub>3</sub>H<sub>2</sub>, wherein

R<sup>h1</sup> and R<sup>h2</sup> are each independently selected from the group consisting of H, C<sub>1-6</sub> alkyl, and C<sub>1-4</sub> hydroxyalkyl;

the C<sub>1-8</sub> alkyl portions of R<sup>h</sup> are optionally further substituted with from 1 to 3 substituents independently selected from OH, COOH, SO<sub>2</sub>NH<sub>2</sub>, CONH<sub>2</sub>, C(O)NHOH, COO-C<sub>1-8</sub> alkyl, PO<sub>3</sub>H<sub>2</sub> and C<sub>5-6</sub> heteroaryl optionally substituted with 1 to 2 C<sub>1-3</sub> alkyl substituents,

the C<sub>5-10</sub> heteroaryl and the C<sub>6-10</sub> aryl portions of R<sup>h</sup> are optionally substituted with 1 to 3 substituents independently selected from OH, B(OH)<sub>2</sub>, COOH, SO<sub>2</sub>NH<sub>2</sub>, CONH<sub>2</sub>, C(O)NHOH, PO<sub>3</sub>H<sub>2</sub>, COO-C<sub>1-8</sub>alkyl, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkyl-OH, C<sub>1-4</sub>alkyl-SO<sub>2</sub>NH<sub>2</sub>, C<sub>1-4</sub>alkyl-CONH<sub>2</sub>, C<sub>1-4</sub>alkyl-C(O)NHOH, C<sub>1-4</sub>alkyl- PO<sub>3</sub>H<sub>2</sub>, C<sub>1-4</sub>alkyl-COOH, and phenyl and the C<sub>4-8</sub> heterocyclyl and C<sub>3-10</sub> cycloalkyl portions of R<sup>h</sup> are optionally substituted with 1 to 4 R<sup>w</sup> substituents;

each R<sup>w</sup> substituent is independently selected from C<sub>1-4</sub> alkyl, C<sub>1-4</sub> alkyl-OH, C<sub>1-4</sub> alkyl-COOH, C<sub>1-4</sub> alkyl-SO<sub>2</sub>NH<sub>2</sub>, C<sub>1-4</sub> alkyl CONH<sub>2</sub>, C<sub>1-4</sub> alkyl-C(O)NHOH, C<sub>1-4</sub> alkyl-PO<sub>3</sub>H, OH, COO-C<sub>1-8</sub> alkyl, COOH, SO<sub>2</sub>NH<sub>2</sub>, CONH<sub>2</sub>, C(O)NHOH, PO<sub>3</sub>H<sub>2</sub> and oxo;

R<sup>4</sup> is selected from the group consisting of O-C<sub>1-8</sub> alkyl, O-C<sub>1-8</sub> haloalkyl, C<sub>6-10</sub> aryl, C<sub>5-10</sub> heteroaryl, -O-C<sub>1-4</sub> alkyl-C<sub>4-7</sub> heterocycloalkyl, -O-C<sub>1-4</sub> alkyl-C<sub>6-10</sub>aryl and -O-C<sub>1-4</sub> alkyl-C<sub>5-10</sub> heteroaryl, each of which is optionally substituted with 1 to 5 R<sup>4a</sup>;

each R<sup>4a</sup> is independently selected from the group consisting of halogen, -CN, -R<sup>m</sup>, -CO<sub>2</sub>R<sup>n</sup>, -CONR<sup>n</sup>R<sup>p</sup>, -C(O)R<sup>n</sup>, -OC(O)NR<sup>n</sup>R<sup>p</sup>, -NR<sup>n</sup>C(O)R<sup>p</sup>, -NR<sup>n</sup>C(O)<sub>2</sub>R<sup>m</sup>, -NR<sup>n</sup>-C(O)NR<sup>n</sup>R<sup>p</sup>,

-NR<sup>n</sup>R<sup>p</sup>, -OR<sup>n</sup>, -O-X<sup>4</sup>-OR<sup>n</sup>, -O-X<sup>4</sup>-NR<sup>n</sup>R<sup>p</sup>, -O-X<sup>4</sup>-CO<sub>2</sub>R<sup>n</sup>, -O-X<sup>4</sup>-CONR<sup>n</sup>R<sup>p</sup>,  
 -X<sup>4</sup>-OR<sup>n</sup>, -X<sup>4</sup>-NR<sup>n</sup>R<sup>p</sup>, -X<sup>4</sup>-CO<sub>2</sub>R<sup>n</sup>, -X<sup>4</sup>-CONR<sup>n</sup>R<sup>p</sup>, -SF<sub>5</sub>, -S(O)<sub>2</sub>R<sup>n</sup>R<sup>p</sup>, -S(O)<sub>2</sub>NR<sup>n</sup>R<sup>p</sup>, C<sub>3-7</sub>  
 cycloalkyl and C<sub>4-7</sub> heterocycloalkyl, wherein the cycloalkyl and heterocycloalkyl rings  
 are optionally substituted with 1 to 5 R<sup>t</sup>, wherein each R<sup>t</sup> is independently selected from  
 5 the group consisting of C<sub>1-8</sub> alkyl, C<sub>1-8</sub> haloalkyl, -CO<sub>2</sub>R<sup>n</sup>, -CONR<sup>n</sup>R<sup>p</sup>, -C(O)R<sup>n</sup>,  
 -OC(O)NR<sup>n</sup>R<sup>p</sup>, -NR<sup>n</sup>C(O)R<sup>p</sup>, -NR<sup>n</sup>C(O)<sub>2</sub>R<sup>m</sup>, -NR<sup>n</sup>-C(O)NR<sup>n</sup>R<sup>p</sup>, -NR<sup>n</sup>R<sup>p</sup>, -OR<sup>n</sup>,  
 -O-X<sup>4</sup>-OR<sup>n</sup>, -O-X<sup>4</sup>-NR<sup>n</sup>R<sup>p</sup>, -O-X<sup>4</sup>-CO<sub>2</sub>R<sup>n</sup>, -O-X<sup>4</sup>-CONR<sup>n</sup>R<sup>p</sup>, -X<sup>4</sup>-OR<sup>n</sup>, -X<sup>4</sup>-NR<sup>n</sup>R<sup>p</sup>,  
 -X<sup>4</sup>-CO<sub>2</sub>R<sup>n</sup>, -X<sup>4</sup>-CONR<sup>n</sup>R<sup>p</sup>, -SF<sub>5</sub>, and -S(O)<sub>2</sub>NR<sup>n</sup>R<sup>p</sup>;

wherein each X<sup>4</sup> is a C<sub>1-6</sub> alkylene; each R<sup>n</sup> and R<sup>p</sup> is independently selected from hydrogen, C<sub>1-8</sub>  
 10 alkyl, and C<sub>1-8</sub> haloalkyl, or when attached to the same nitrogen atom can be combined  
 with the nitrogen atom to form a five or six-membered ring having from 0 to 2 additional  
 heteroatoms as ring members selected from N, O or S, and optionally substituted with  
 oxo; each R<sup>m</sup> is independently selected from the group consisting of C<sub>1-8</sub> alkyl, C<sub>2-8</sub>  
 alkenyl, and C<sub>1-8</sub> haloalkyl; and optionally when two R<sup>4a</sup> substituents are on adjacent  
 15 atoms, they are combined to form a fused five or six-membered carbocyclic or  
 heterocyclic ring optionally substituted with oxo;

n is 0, 1, 2 or 3;

each R<sup>5</sup> is independently selected from the group consisting of halogen, -CN, -R<sup>q</sup>, -CO<sub>2</sub>R<sup>r</sup>,  
 -CONR<sup>r</sup>R<sup>s</sup>, -C(O)R<sup>r</sup>, -OC(O)NR<sup>r</sup>R<sup>s</sup>, -NR<sup>r</sup>C(O)R<sup>s</sup>, -NR<sup>r</sup>C(O)<sub>2</sub>R<sup>q</sup>, -NR<sup>r</sup>-C(O)NR<sup>r</sup>R<sup>s</sup>,  
 20 -NR<sup>r</sup>R<sup>s</sup>, -OR<sup>r</sup>, -O-X<sup>5</sup>-OR<sup>r</sup>, -O-X<sup>5</sup>-NR<sup>r</sup>R<sup>s</sup>, -O-X<sup>5</sup>-CO<sub>2</sub>R<sup>r</sup>, -O-X<sup>5</sup>-CONR<sup>r</sup>R<sup>s</sup>, -X<sup>5</sup>-OR<sup>r</sup>,  
 -X<sup>5</sup>-NR<sup>r</sup>R<sup>s</sup>, -X<sup>5</sup>-CO<sub>2</sub>R<sup>r</sup>, -X<sup>5</sup>-CONR<sup>r</sup>R<sup>s</sup>, -SF<sub>5</sub>, -S(O)<sub>2</sub>NR<sup>r</sup>R<sup>s</sup>, wherein each X<sup>5</sup> is a C<sub>1-4</sub>  
 alkylene; each R<sup>r</sup> and R<sup>s</sup> is independently selected from hydrogen, C<sub>1-8</sub> alkyl, and C<sub>1-8</sub>  
 haloalkyl, or when attached to the same nitrogen atom can be combined with the nitrogen  
 atom to form a five or six-membered ring having from 0 to 2 additional heteroatoms as  
 25 ring members selected from N, O or S, and optionally substituted with oxo; each R<sup>q</sup> is  
 independently selected from the group consisting of C<sub>1-8</sub> alkyl, and C<sub>1-8</sub> haloalkyl;

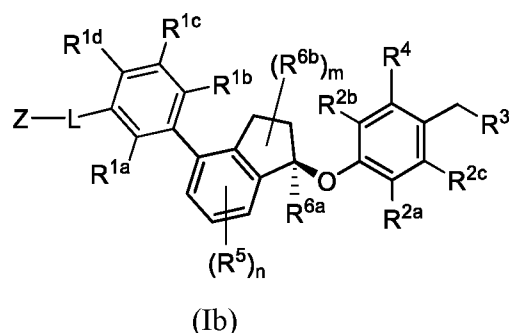
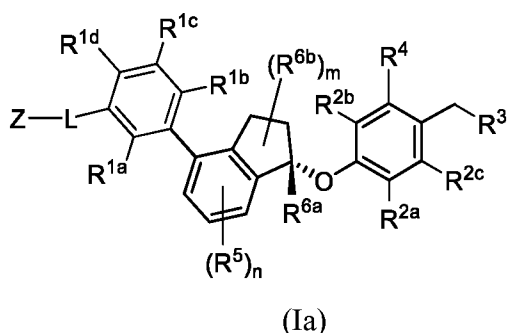
R<sup>6a</sup> is selected from the group consisting of H, C<sub>1-4</sub> alkyl and C<sub>1-4</sub> haloalkyl;

m is 0, 1, 2, 3 or 4;

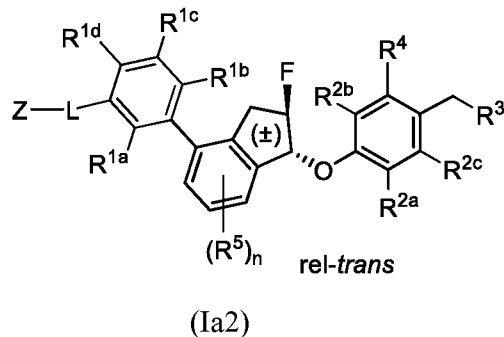
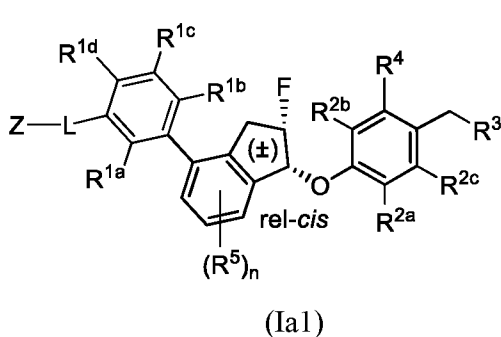
each R<sup>6b</sup> is independently selected from the group consisting of F, C<sub>1-4</sub> alkyl, O-R<sup>u</sup>, C<sub>1-4</sub>  
 30 haloalkyl, NR<sup>u</sup>R<sup>v</sup>, wherein each R<sup>u</sup> and R<sup>v</sup> is independently selected from hydrogen, C<sub>1-8</sub>

alkyl, and C<sub>1-8</sub> haloalkyl, or when attached to the same nitrogen atom can be combined with the nitrogen atom to form a five or six-membered ring having from 0 to 2 additional heteroatoms as ring members selected from N, O or S, and optionally substituted with oxo.

- 5 [0036] In some embodiments, the present disclosure provides compounds having formula (Ia) or (Ib):



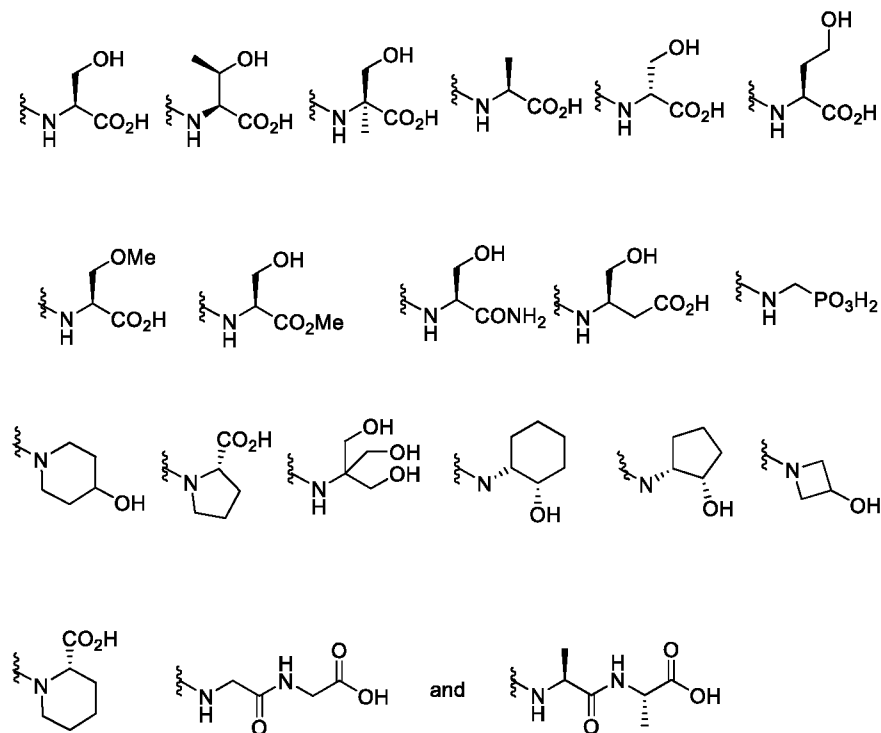
- [0037] In some embodiments, the present disclosure provides compounds having formula (Ia1) or (Ia2):
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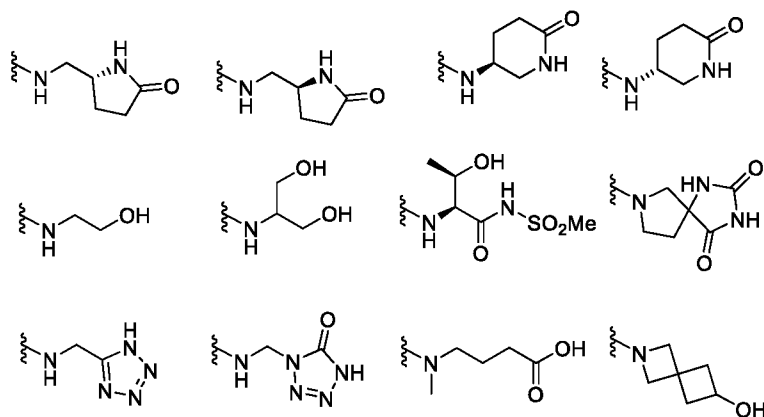
- [0038] In some embodiments, for each of formula (I), (Ia), (Ia1), (Ia2) and (Ib), or a pharmaceutically acceptable salt thereof, each of R<sup>2a</sup>, R<sup>2b</sup> and R<sup>2c</sup> is independently selected from the group consisting of hydrogen, halogen, CN, C<sub>1-4</sub> alkyl, and C<sub>1-4</sub> haloalkyl.
- 15

- [0039] In some embodiments, for each of formula (I), (Ia), (Ia1), (Ia2) and (Ib), or a pharmaceutically acceptable salt thereof, R<sup>2b</sup> and R<sup>2c</sup> are both H and R<sup>2a</sup> is selected from the group consisting of halogen, C<sub>1-4</sub> alkyl, C<sub>2-4</sub> alkenyl, C<sub>1-3</sub> haloalkyl, -CN, -OMe and OEt. In some embodiments, R<sup>2b</sup> and R<sup>2c</sup> are both H and R<sup>2a</sup> is halogen. In some embodiments, R<sup>2b</sup> and R<sup>2c</sup> are both H and R<sup>2a</sup> is Cl.
- 20

**[0040]** In some embodiments, for each of formula (I), (Ia), (Ia1), (Ia2) and (Ib), or a pharmaceutically acceptable salt thereof, R<sup>3</sup> is NR<sup>g</sup>R<sup>h</sup>. In some embodiments, R<sup>3</sup> is selected from the group consisting of:



5    **[0041]** In some embodiments, for each of formula (I), (Ia), (Ia1), (Ia2) and (Ib), or a pharmaceutically acceptable salt thereof, R<sup>3</sup> is -NR<sup>g</sup>R<sup>h</sup>, and is selected from the group consisting of



[0042] In some embodiments, for each of formula (I), (Ia), (Ia1), (Ia2) and (Ib), or a  
10 pharmaceutically acceptable salt thereof, R<sup>3</sup> is -NR<sup>g</sup>R<sup>h</sup>, and R<sup>h</sup> combined with the N to which it



is attached is a mono-, di- or tri-peptide comprising 1-3 natural amino acids and 0-2 non-natural amino acids, wherein

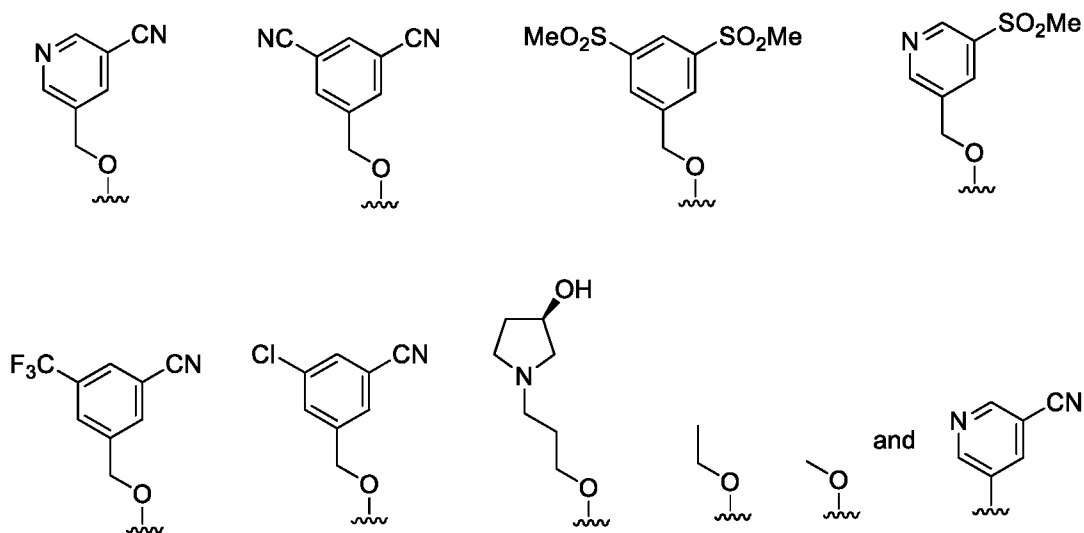
the non-natural aminoacids have an alpha carbon substituent selected from the group consisting of C<sub>2-4</sub> hydroxyalkyl, C<sub>1-3</sub> alkyl-guanidiny, and C<sub>1-4</sub> alkyl-heteroaryl,

5 the alpha carbon of each natural or non-natural amino acids are optionally further substituted with a methyl group, and

the terminal moiety of the mono-, di-, or tri-peptide is selected from the group consisting of C(O)OH, C(O)O-C<sub>1-6</sub> alkyl, and PO<sub>3</sub>H<sub>2</sub>.

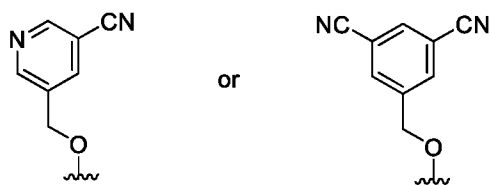
[0043] In some embodiments, for each of formula (I), (Ia), (Ia1), (Ia2) and (Ib), or a  
10 pharmaceutically acceptable salt thereof, each natural amino acid of R<sup>h</sup> is independently selected from the group consisting of serine, alanine, glycine, lysine, arginine, threonine, phenylalanine, tyrosine, aspartate, asparagine, histidine, and leucine.

[0044] In some embodiments, for each of formula (I), (Ia), (Ia1), (Ia2) and (Ib), or a pharmaceutically acceptable salt thereof, R<sup>4</sup> is selected from the group consisting of:



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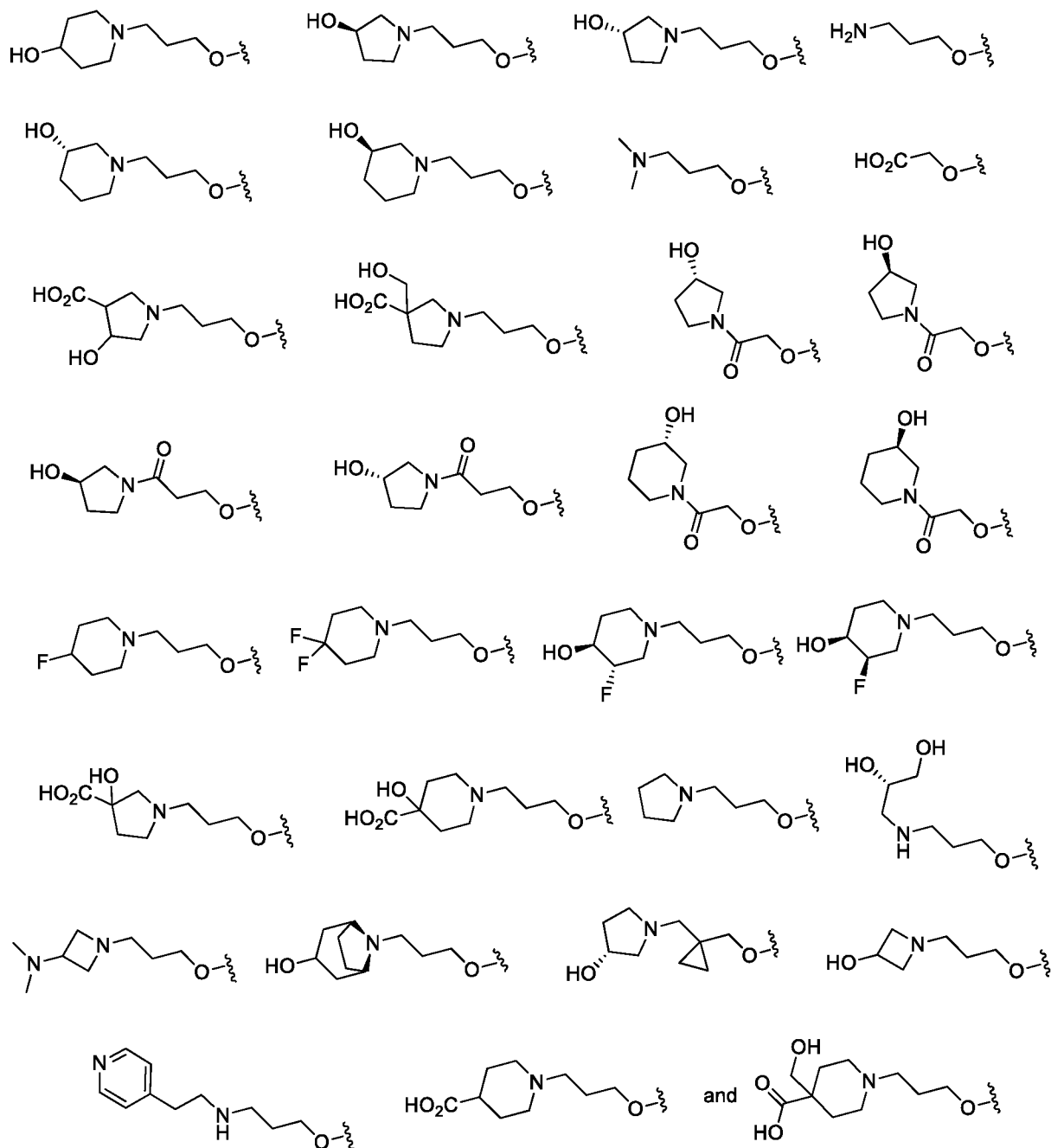
In selected embodiments, R<sup>4</sup> is selected from the group consisting of:



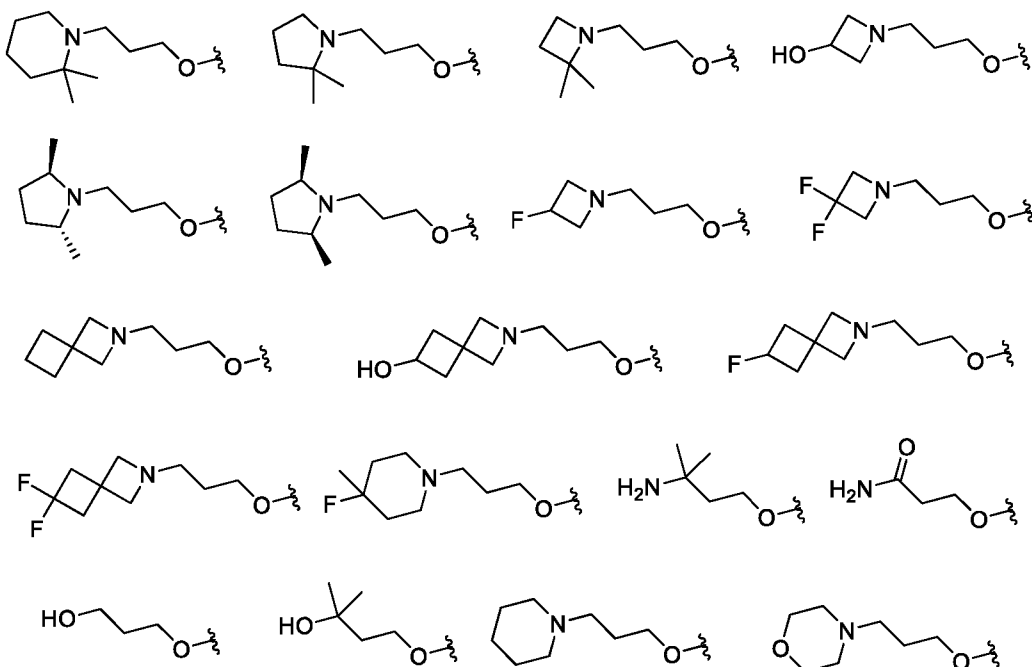
[0045] In some embodiments, for each of formula (I), (Ia), (Ia1), (Ia2) and (Ib), or a pharmaceutically acceptable salt thereof, n is 0.

[0046] In some embodiments, for each of formula (I), (Ia), (Ia1), (Ia2) and (Ib), or a pharmaceutically acceptable salt thereof, R<sup>6a</sup> and R<sup>6b</sup> are each independently selected from the group consisting of hydrogen, halogen, C<sub>1-4</sub> alkyl and C<sub>1-4</sub> haloalkyl.

[0047] In some embodiments, for each of formula (I), (Ia), (Ia1), (Ia2) and (Ib), or a pharmaceutically acceptable salt thereof, the group Z-L- is selected from the group consisting of:



[0048] In some embodiments, for each of formula (I), (Ia), (Ia1), (Ia2) and (Ib), or a pharmaceutically acceptable salt thereof, the group Z-L- is selected from the group consisting of:



[0049] In some embodiments, for each of formula (I), (Ia), (Ia1), (Ia2) and (Ib), or a pharmaceutically acceptable salt thereof, R<sup>6a</sup> is H.

[0050] In some embodiments, for each of formula (I), (Ia) and (Ib), or a pharmaceutically acceptable salt thereof, m is 0.

[0051] In some embodiments, for each of formula (I), (Ia) and (Ib), or a pharmaceutically acceptable salt thereof, m is 1 and R<sup>6b</sup> is selected from the group consisting of F, C<sub>1-4</sub> alkyl, O-R<sup>u</sup>, C<sub>1-4</sub> haloalkyl and NR<sup>u</sup>R<sup>v</sup>, wherein each R<sup>u</sup> and R<sup>v</sup> is independently selected from hydrogen, C<sub>1-8</sub> alkyl, and C<sub>1-8</sub> haloalkyl.

[0052] In some embodiments, for each of formula (I), (Ia) and (Ib), or a pharmaceutically acceptable salt thereof, m is 1 and R<sup>6b</sup> is F.

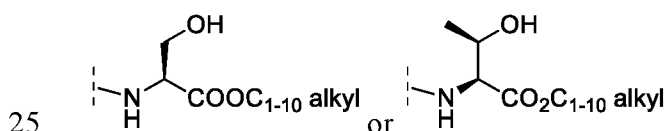
[0053] In addition to the compounds provided above, pharmaceutically acceptable salts of those compounds are also provided. In some embodiments, the pharmaceutically acceptable salts are selected from ammonium, calcium, magnesium, potassium, sodium, zinc, arginine, betaine, caffeine, choline, N,N'-dibenzylethylenediamine, diethylamine, 2-diethylaminoethanol, 2-dimethylaminoethanol, ethanolamine, ethylenediamine, N-ethylmorpholine, N-ethylpiperidine, glucamine, glucosamine, histidine, hydrabamine, isopropylamine, lysine, methylglucamine,

morpholine, piperazine, piperadine, procaine, purines, theobromine, triethylamine, trimethylamine, tripropylamine, tromethamine, hydrochloric, carbonic, monohydrogencarbonic, phosphoric, monohydrogenphosphoric, dihydrogenphosphoric, acetic, propionic, isobutyric, malonic, benzoic, succinic, suberic, fumaric, mandelic, phthalic, benzenesulfonic, p-

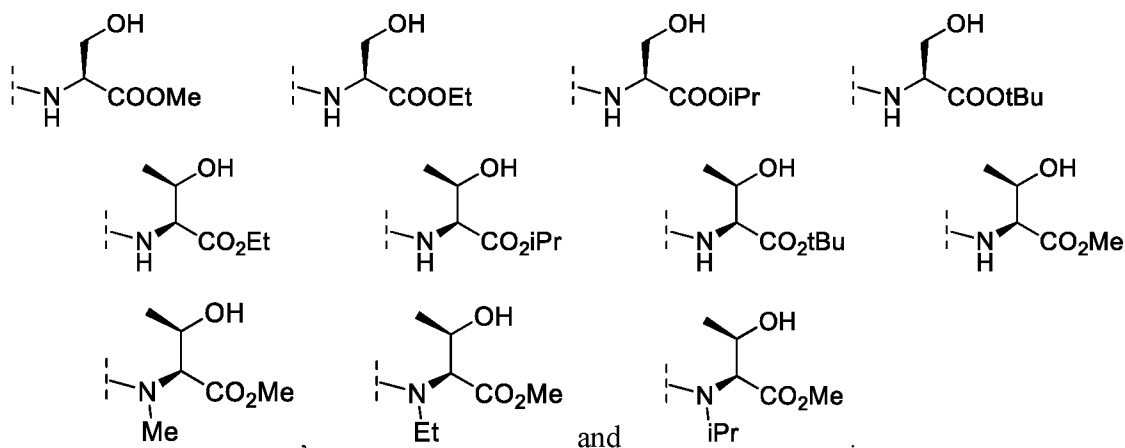
5 tolylsulfonic, citric, tartaric, methanesulfonic, arginate, glucuronic acid and galactunoric acids. In some embodiments, the pharmaceutically acceptable salts are selected from ammonium, calcium, magnesium, potassium, sodium, hydrochloric, carbonic, monohydrogencarbonic, phosphoric, monohydrogenphosphoric, dihydrogenphosphoric, acetic, propionic, isobutyric, malonic, benzoic, succinic, suberic, fumaric, mandelic, phthalic, benzenesulfonic, p-tolylsulfonic, citric,  
10 tartaric, methanesulfonic, arginate, glucuronic acid and galactunoric acids. In some embodiments, the pharmaceutically acceptable salts are sodium or hydrochloric.

**[0054]** In addition to salt forms, the present disclosure provides compounds which are in a prodrug form. Prodrugs of the compounds described herein are those compounds that readily undergo chemical changes under physiological conditions to provide the compounds of the  
15 present disclosure. Additionally, prodrugs can be converted to the compounds of the present disclosure by chemical or biochemical methods in an ex vivo environment. For example, prodrugs can be slowly converted to the compounds of the present disclosure when placed in a transdermal patch reservoir with a suitable enzyme or chemical reagent.

**[0055]** An ester may be used as a prodrug for the corresponding carboxylic acid. A C<sub>1-10</sub> alkyl ester or a C<sub>1-10</sub> haloalkyl ester may be used as a prodrug for the corresponding carboxylic acid.  
20 The following esters may be used: ter-butyl ester, methyl ester, ethyl ester, isopropyl ester. More specifically, ester prodrugs may be used as R<sup>3</sup> groups such as threonine or serine prodrug esters which are linked to the rest of the molecule through their nitrogen. More specifically, the following prodrugs may be used for R<sup>3</sup>:



**[0056]** More specifically, the following prodrugs may be used for R<sup>3</sup>:



## 5 PHARMACEUTICAL COMPOSITIONS

[0057] In addition to the compounds provided herein, compositions of those compounds will typically contain a pharmaceutical carrier or diluent.

[0058] The term "composition" as used herein is intended to encompass a product comprising the specified ingredients in the specified amounts, as well as any product which results, directly or indirectly, from combination of the specified ingredients in the specified amounts. By "pharmaceutically acceptable" it is meant the carrier, diluent or excipient must be compatible with the other ingredients of the formulation and not deleterious to the recipient thereof.

[0059] In another embodiment, a pharmaceutical composition comprising a compound of the present disclosure including a compound of Formula (II), (IIa), (IIb), (I), (Ia), or (Ib) or a pharmaceutically acceptable salt thereof, and a pharmaceutically acceptable excipient, is provided.

[0060] In some embodiments, the pharmaceutical composition further comprises one or more additional therapeutic agents. In some embodiments, the one or more additional therapeutic agent is selected from the group consisting of an antimicrobial agent, an antiviral agent, a cytotoxic agent, a gene expression modulatory agent, a chemotherapeutic agent, an anti-cancer agent, an anti-angiogenic agent, an immunotherapeutic agent, an anti-hormonal agent, an anti-fibrotic agent, radiotherapy, a radiotherapeutic agent, an anti-neoplastic agent, and an anti-proliferation agent. In some embodiments, the one or more additional therapeutic agent is selected from the

group consisting of one or more of CCX354, CCX9588, CCX140, CCX872, CCX598, CCX6239, CCX9664, CCX2553, CCX 2991, CCX282, CCX025, CCX507, CCX430, CCX765, CCX224, CCX662, CCX650, CCX832, CCX168, and CCX168-M1.

[0061] The pharmaceutical compositions for the administration of the compounds of this disclosure may conveniently be presented in unit dosage form and may be prepared by any of the methods well known in the art of pharmacy and drug delivery. All methods include the step of bringing the active ingredient into association with the carrier which constitutes one or more accessory ingredients. In general, the pharmaceutical compositions are prepared by uniformly and intimately bringing the active ingredient into association with a liquid carrier or a finely divided solid carrier or both, and then, if necessary, shaping the product into the desired formulation. In the pharmaceutical composition the active object compound is included in an amount sufficient to produce the desired effect upon the process or condition of diseases.

[0062] The pharmaceutical compositions containing the active ingredient may be in a form suitable for oral use, for example, as tablets, troches, lozenges, aqueous or oily suspensions, dispersible powders or granules, emulsions and self-emulsifications as described in U.S. Patent Application 2002-0012680, hard or soft capsules, syrups, elixirs, solutions, buccal patch, oral gel, chewing gum, chewable tablets, effervescent powder and effervescent tablets. Compositions intended for oral use may be prepared according to any method known to the art for the manufacture of pharmaceutical compositions and such compositions may contain one or more agents selected from the group consisting of sweetening agents, flavoring agents, coloring agents, antioxidants and preserving agents in order to provide pharmaceutically elegant and palatable preparations. Tablets contain the active ingredient in admixture with non-toxic pharmaceutically acceptable excipients which are suitable for the manufacture of tablets. These excipients may be for example, inert diluents, such as cellulose, silicon dioxide, aluminum oxide, calcium carbonate, sodium carbonate, glucose, mannitol, sorbitol, lactose, calcium phosphate or sodium phosphate; granulating and disintegrating agents, for example, corn starch, or alginic acid; binding agents, for example PVP, cellulose, PEG, starch, gelatin or acacia, and lubricating agents, for example magnesium stearate, stearic acid or talc. The tablets may be uncoated or they may be coated, enterically or otherwise, by known techniques to delay disintegration and absorption in the gastrointestinal tract and thereby provide a sustained action over a longer

period. For example, a time delay material such as glyceryl monostearate or glyceryl distearate may be employed. They may also be coated by the techniques described in the U.S. Pat. Nos. 4,256,108; 4,166,452; and 4,265,874 to form osmotic therapeutic tablets for control release.

[0063] Formulations for oral use may also be presented as hard gelatin capsules wherein the active ingredient is mixed with an inert solid diluent, for example, calcium carbonate, calcium phosphate or kaolin, polyethylene glycol (PEG) of various average sizes (e.g., PEG400, PEG4000) and certain surfactants such as cremophor or solutol, or as soft gelatin capsules wherein the active ingredient is mixed with water or an oil medium, for example peanut oil, liquid paraffin, or olive oil. Additionally, emulsions can be prepared with a non-water miscible ingredient such as oils and stabilized with surfactants such as mono- or di-glycerides, PEG esters and the like.

[0064] Aqueous suspensions contain the active materials in admixture with excipients suitable for the manufacture of aqueous suspensions. Such excipients are suspending agents, for example sodium carboxymethylcellulose, methylcellulose, hydroxy-propylmethylcellulose, sodium alginate, polyvinyl-pyrrolidone, gum tragacanth and gum acacia; dispersing or wetting agents may be a naturally-occurring phosphatide, for example lecithin, or condensation products of an alkylene oxide with fatty acids, for example polyoxy-ethylene stearate, or condensation products of ethylene oxide with long chain aliphatic alcohols, for example heptadecaethyleneoxycetanol, or condensation products of ethylene oxide with partial esters derived from fatty acids and a hexitol such as polyoxyethylene sorbitol monooleate, or condensation products of ethylene oxide with partial esters derived from fatty acids and hexitol anhydrides, for example polyethylene sorbitan monooleate. The aqueous suspensions may also contain one or more preservatives, for example ethyl, or n-propyl, p-hydroxybenzoate, one or more coloring agents, one or more flavoring agents, and one or more sweetening agents, such as sucrose or saccharin.

[0065] Oily suspensions may be formulated by suspending the active ingredient in a vegetable oil, for example arachis oil, olive oil, sesame oil or coconut oil, or in a mineral oil such as liquid paraffin. The oily suspensions may contain a thickening agent, for example beeswax, hard paraffin or cetyl alcohol. Sweetening agents such as those set forth above, and flavoring agents



may be added to provide a palatable oral preparation. These compositions may be preserved by the addition of an anti-oxidant such as ascorbic acid.

[0066] Dispersible powders and granules suitable for preparation of an aqueous suspension by the addition of water provide the active ingredient in admixture with a dispersing or wetting agent, suspending agent and one or more preservatives. Suitable dispersing or wetting agents and suspending agents are exemplified by those already mentioned above. Additional excipients, for example sweetening, flavoring and coloring agents, may also be present.

[0067] The pharmaceutical compositions of the disclosure may also be in the form of oil-in-water emulsions. The oily phase may be a vegetable oil, for example olive oil or arachis oil, or a mineral oil, for example liquid paraffin or mixtures of these. Suitable emulsifying agents may be naturally-occurring gums, for example gum acacia or gum tragacanth, naturally-occurring phosphatides, for example soy bean, lecithin, and esters or partial esters derived from fatty acids and hexitol anhydrides, for example sorbitan monooleate, and condensation products of the said partial esters with ethylene oxide, for example polyoxyethylene sorbitan monooleate. The emulsions may also contain sweetening and flavoring agents.

[0068] Syrups and elixirs may be formulated with sweetening agents, for example glycerol, propylene glycol, sorbitol or sucrose. Such formulations may also contain a demulcent, a preservative and flavoring and coloring agents. Oral solutions can be prepared in combination with, for example, cyclodextrin, PEG and surfactants.

[0069] The pharmaceutical compositions may be in the form of a sterile injectable aqueous or oleagenous suspension. This suspension may be formulated according to the known art using those suitable dispersing or wetting agents and suspending agents which have been mentioned above. The sterile injectable preparation may also be a sterile injectable solution or suspension in a non-toxic parenterally-acceptable diluent or solvent, for example as a solution in 1,3-butane diol. Among the acceptable vehicles and solvents that may be employed are water, Ringer's solution and isotonic sodium chloride solution. In addition, sterile, fixed oils are conventionally employed as a solvent or suspending medium. For this purpose any bland fixed oil may be employed including synthetic mono- or diglycerides. In addition, fatty acids such as oleic acid find use in the preparation of injectables.

[0070] The compounds of the present disclosure may also be administered in the form of suppositories for rectal administration of the drug. These compositions can be prepared by mixing the drug with a suitable non-irritating excipient which is solid at ordinary temperatures but liquid at the rectal temperature and will therefore melt in the rectum to release the drug.

5 Such materials include cocoa butter and polyethylene glycols. Additionally, the compounds can be administered via ocular delivery by means of solutions or ointments. Still further, transdermal delivery of the subject compounds can be accomplished by means of iontophoretic patches and the like. For topical use, creams, ointments, jellies, solutions or suspensions, etc., containing the compounds of the present disclosure are employed. As used herein, topical application is also  
10 meant to include the use of mouth washes and gargles.

[0071] The compounds of this disclosure may also be coupled a carrier that is a suitable polymers as targetable drug carriers. Such polymers can include polyvinylpyrrolidone, pyran copolymer, polyhydroxy-propyl-methacrylamide-phenol, polyhydroxyethyl-aspartamide-phenol, or polyethyleneoxide-polylysine substituted with palmitoyl residues. Furthermore, the  
15 compounds of the disclosure may be coupled to a carrier that is a class of biodegradable polymers useful in achieving controlled release of a drug, for example polylactic acid, polyglycolic acid, copolymers of polylactic and polyglycolic acid, polyepsilon caprolactone, polyhydroxy butyric acid, polyorthoesters, polyacetals, polydihydropyrans, polycyanoacrylates and cross linked or amphipathic block copolymers of hydrogels. Polymers and semipermeable  
20 polymer matrices may be formed into shaped articles, such as valves, stents, tubing, prostheses and the like. In one embodiment of the disclosure, the compound of the disclosure is coupled to a polymer or semipermeable polymer matrix that is formed as a stent or stent-graft device.

## METHODS OF TREATING DISEASES AND DISORDERS

[0072] The compounds of the disclosure may be used as immunomodulators. The compounds  
25 of the disclosure may be used as agonists, antagonists, partial agonists, inverse agonists, inhibitors of PD-1 and/or PD-L1 in a variety of contexts, both *in vitro* and *in vivo*. In some embodiments, the compounds of the disclosure may be used as inhibitors of the PD-1/PD-L1 protein protein interaction. In some embodiments, the compounds of the disclosure may be used as inhibitors of PD-L1. In some embodiments, the compounds of the disclosure may be used as

inhibitors of the CD80/PD-L1 protein protein interaction. In some embodiments, the compounds of the disclosure may be used to inhibit the interaction between PD-1 and PD-L1 and/or PD-1 and CD80 and/or PD-1 and PD-L2 *in vitro* or *in vivo*. In some embodiments, the compounds of the disclosure may be used to inhibit VISTA and/or TIM-3. In some embodiments, the

5 compounds of the disclosure may be inhibitors of the PD-1/PD-L1 protein protein interaction and inhibitors of VISTA and/or TIM-3. In some embodiments, in addition to being inhibitors of the PD-1/PD-L1 protein protein interaction, the compounds of the disclosure may be inhibitors of CTLA-4 and/or BTLA and/or LAG-3 and/or KLRG-1 and/or 2B4 and/or CD160 and/or HVEM and/or CD48 and/or E-cadherin and/or MHC-II and/or galectin-9 and/or CD86 and/or

10 PD-L2 and/or VISTA and/or TIM-3 and/or CD80.

[0073] The compounds of the disclosure may be contacted with the receptor they interact with, in aqueous solution and under conditions otherwise suitable for binding of the ligand to the receptor. The receptor may be present in suspension (*e.g.*, in an isolated membrane or cell preparation), in a cultured or isolated cell, or in a tissue or organ.

15 [0074] Preferably, the amount of the compounds of the disclosure contacted with the receptor should be sufficient to inhibit the PD-1/PD-L1 binding *in vitro* as measured, for example, using an ELISA. The receptor may be present in solution or suspension, in a cultured or isolated cell preparation or within a patient.

[0075] In some embodiments, the compounds of the present disclosure are useful for restoring

20 and augmenting T cell activation. In some embodiments, the compounds of the present disclosure are useful for enhancing an immune response in a patient. In some embodiments, the compounds of the present disclosure are useful for treating, preventing, or slowing the progression of diseases or disorders in a variety of therapeutic areas, such as cancer and infectious diseases.

25 [0076] In some embodiments, the compounds of the present disclosure can be used for treating patients suffering from conditions that are responsive to PD-1/PD-L1 protein protein interaction modulation.

[0077] In some embodiments, a method of modulating an immune response mediated by the PD-1 signaling pathway in a subject, comprising administering to the subject a therapeutically

effective amount of a compound of the present disclosure including a compound of Formula (I), (Ia), or (Ib), or a pharmaceutically acceptable salt thereof or a composition comprising a compound of Formula (I), (Ia), or (Ib), or a pharmaceutically acceptable salt thereof, is provided.

- 5 [0078] In some embodiments, a method of enhancing, stimulating, modulating and/or increasing the immune response in a subject in need thereof, comprising administering to the subject a therapeutically effective amount of a compound of the present disclosure including a compound of Formula (I), (Ia), or (Ib), or a pharmaceutically acceptable salt thereof or a composition of a compound of the present disclosure including a compound of Formula (I), (Ia),  
10 or (Ib), or a pharmaceutically acceptable salt thereof, is provided.

- [0079] In some embodiments, a method of inhibiting growth, proliferation, or metastasis of cancer cells in a subject in need thereof, comprising administering to the subject a therapeutically effective amount of a compound of the present disclosure including a compound of Formula (II), (IIa), (IIb), (I), (Ia), or (Ib), or a pharmaceutically acceptable salt thereof or a composition of a  
15 compound of the present disclosure including a compound of Formula (II), (IIa), (IIb), (I), (Ia), or (Ib), or a pharmaceutically acceptable salt thereof, is provided.

- [0080] In some embodiments, a method of treating a subject in need thereof, comprising administering to the subject a therapeutically effective amount of a compound of the present disclosure including a compound of Formula (I), (Ia), or (Ib), or a pharmaceutically acceptable  
20 salt thereof or a composition of a compound of the present disclosure including a compound of Formula (I), (Ia), or (Ib), or a pharmaceutically acceptable salt thereof, is provided.

- [0081] In some embodiments, the subject suffers from a disease or disorder selected from the group consisting of an infectious disease, a bacterial infectious disease, a viral infectious disease, a fungal infectious disease, a solid tumor, a hematological malignancy, an immune disorder, an  
25 inflammatory disease, and cancer. In some embodiments, the disease or disorder is selected from the group consisting of melanoma, glioblastoma, esophagus tumor, nasopharyngeal carcinoma, uveal melanoma, lymphoma, lymphocytic lymphoma, primary CNS lymphoma, T-cell lymphoma, diffuse large B-cell lymphoma, primary mediastinal large B-cell lymphoma, prostate cancer, castration-resistant prostate cancer, chronic myelocytic leukemia, Kaposi's sarcoma

fibrosarcoma, liposarcoma, chondrosarcoma, osteogenic sarcoma, angiosarcoma, lymphangiosarcoma, synovioma, , meningioma, leiomyosarcoma, rhabdomyosarcoma, sarcoma of soft tissue, sarcoma, sepsis, biliary tumor, basal cell carcinoma, thymus neoplasm, cancer of the thyroid gland, cancer of the parathyroid gland, uterine cancer, cancer of the adrenal gland, liver infection, Merkel cell carcinoma, nerve tumor, follicle center lymphoma, colon cancer, Hodgkin's disease, non-Hodgkin's lymphoma, leukemia, chronic or acute leukemias including acute myeloid leukemia, chronic myeloid leukemia, acute lymphoblastic leukemia, chronic lymphocytic leukemia, multiple myeloma, ovary tumor, myelodysplastic syndrome, cutaneous or intraocular malignant melanoma, renal cell carcinoma, small-cell lung cancer, lung cancer, mesothelioma, breast cancer, squamous non-small cell lung cancer (SCLC), non-squamous NSCLC, colorectal cancer, ovarian cancer, gastric cancer, hepatocellular carcinoma, pancreatic carcinoma, pancreatic cancer, Pancreatic ductal adenocarcinoma, squamous cell carcinoma of the head and neck, cancer of the head or neck, gastrointestinal tract, stomach cancer, HIV, Hepatitis A, Hepatitis B, Hepatitis C, hepatitis D, herpes viruses, papillomaviruses, influenza, bone cancer, skin cancer, rectal cancer, cancer of the anal region, testicular cancer, carcinoma of the fallopian tubes, carcinoma of the endometrium, carcinoma of the cervix, carcinoma of the vagina, carcinoma of the vulva, cancer of the esophagus, cancer of the small intestine, cancer of the endocrine system, cancer of the urethra, cancer of the penis, cancer of the bladder, cancer of the kidney, cancer of the ureter, carcinoma of the renal pelvis, neoplasm of the central nervous system (CNS), tumor angiogenesis, spinal axis tumor, brain stem glioma, pituitary adenoma, epidermoid cancer, abestosis, carcinoma, adenocarcinoma, papillary carcinoma, cystadenocarcinoma, bronchogenic carcinoma, renal cell carcinoma, transitional cell carcinoma, choriocarcinoma, seminoma, embryonal carcinoma, wilm's tumor, pleomorphic adenoma, liver cell papilloma, renal tubular adenoma, cystadenoma, papilloma, adenoma, leiomyoma, rhabdomyoma, hemangioma, lymphangioma, osteoma, chondroma, lipoma and fibroma.

**[0082]** In some embodiments, a therapeutically effective amount of one or more additional therapeutic agents is further administered to the subject. In some embodiments, the one or more additional therapeutic agents is selected from the group consisting of an antimicrobial agent, an antiviral agent, a cytotoxic agent, a gene expression modulatory agent, a chemotherapeutic agent, an anti-cancer agent, an anti-angiogenic agent, an immunotherapeutic agent, an anti-hormonal

agent, an anti-fibrotic agent, radiotherapy, a radiotherapeutic agent, an anti-neoplastic agent, and an anti-proliferation agent. In some embodiments, the one or more additional therapeutic agent is selected from the group consisting of one or more of CCX354, CCX9588, CCX140, CCX872, CCX598, CCX6239, CCX9664, CCX2553, CCX 2991, CCX282, CCX025, CCX507, CCX430, CCX765, CCX224, CCX662, CCX650, CCX832, CCX168, and CCX168-M1.

[0083] In some embodiments, the compounds of the present disclosure may be used to inhibit an infectious disease. The infectious disease includes but is not limited to HIV, Influenza, Herpes, Giardia, Malaria, Leishmania, the pathogenic infection by the virus Hepatitis (A, B, and C), herpes virus (e.g., VZV, HSV-I, HAV-6, HSV-II, and CMV, Epstein Barr virus), adenovirus, influenza virus, flaviviruses, echovirus, rhinovirus, coxsackie virus, cornovirus, respiratory syncytial virus, mumps virus, rotavirus, measles virus, rubella virus, parvovirus, vaccinia virus, HTLV virus, dengue virus, papillomavirus, molluscum virus, poliovirus, rabies virus, JC virus and arboviral encephalitis virus, pathogenic infection by the bacteria chlamydia, rickettsial bacteria, mycobacteria, staphylococci, streptococci, pneumonococci, meningococci and conococci, klebsiella, proteus, serratia, pseudomonas, E. coli, legionella, diphtheria, salmonella, bacilli, cholera, tetanus, botulism, anthrax, plague, leptospirosis, and Lyme's disease bacteria, pathogenic infection by the fungi Candida (albicans, krusei, glabrata, tropicalis, etc.), Cryptococcus neoformans, Aspergillus (fumigatus, niger, etc.), Genus Mucorales (mucor, absidia, rhizophus), Sporothrix schenkii, Blastomyces dermatitidis, Paracoccidioides brasiliensis, Coccidioides immitis and Histoplasma capsulatum, and pathogenic infection by the parasites Entamoeba histolytica, Balantidium coli, Naegleria fowleri, Acanthamoeba sp., Giardia lamblia, Cryptosporidium sp., Pneumocystis carinii, Plasmodium vivax, Babesia microti, Trypanosoma brucei, Trypanosoma cruzi, Leishmania donovani, Toxoplasma gondi, Nippostrongylus brasiliensis.

[0084] In some embodiments, the compounds of the present disclosure may be used to inhibit HIV infection, delay AIDS progression, deplete HIV viral reservoir or decrease the severity of symptoms or HIV infection and AIDS.

[0085] The compounds of the present disclosure may be used for the treatment of cancers and precancerous conditions in a subject.

[0086] Treatment methods provided herein include, in general, administration to a patient an effective amount of one or more compounds provided herein. Suitable patients include those patients suffering from or susceptible to (*i.e.*, prophylactic treatment) a disorder or disease identified herein. Typical patients for treatment as described herein include mammals, particularly primates, especially humans. Other suitable patients include domesticated companion animals such as a dog, cat, horse, and the like, or a livestock animal such as cattle, pig, sheep and the like.

[0087] In general, treatment methods provided herein comprise administering to a patient an effective amount of a compound one or more compounds provided herein. In a preferred embodiment, the compound(s) of the disclosure are preferably administered to a patient (*e.g.*, a human) intravenously, orally or topically. The effective amount may be an amount sufficient to modulate the PD-1/PD-L1 interaction and/or an amount sufficient to reduce or alleviate the symptoms presented by the patient. Preferably, the amount administered is sufficient to yield a plasma concentration of the compound (or its active metabolite, if the compound is a pro-drug) high enough to sufficient to modulate the PD-1/PD-L1 interaction. Treatment regimens may vary depending on the compound used and the particular condition to be treated; for treatment of most disorders, a frequency of administration of 4 times daily or less is preferred. In general, a dosage regimen of 2 times daily is more preferred, with once a day dosing particularly preferred. It will be understood, however, that the specific dose level and treatment regimen for any particular patient will depend upon a variety of factors including the activity of the specific compound employed, the age, body weight, general health, sex, diet, time of administration, route of administration, rate of excretion, drug combination (*i.e.*, other drugs being administered to the patient) and the severity of the particular disease undergoing therapy, as well as the judgment of the prescribing medical practitioner. In general, the use of the minimum dose sufficient to provide effective therapy is preferred. Patients may generally be monitored for therapeutic effectiveness using medical or veterinary criteria suitable for the condition being treated or prevented.

## COMBINATIONS

[0088] A concomitant medicine comprising the compounds of the present disclosure and other drug may be administered as a combination preparation in which both components are contained

in a single formulation, or administered as separate formulations. The administration by separate formulations includes simultaneous administration and administration with some time intervals. In the case of the administration with some time intervals, the compound of the present disclosure can be administered first, followed by another drug or another drug can be administered first, followed by the compound of the present disclosure. The administration method of the respective drugs may be the same or different.

[0089] The dosage of the other drug can be properly selected, based on a dosage that has been clinically used. The compounding ratio of the compound of the present disclosure and the other drug can be properly selected according to age and weight of a subject to be administered, administration method, administration time, disorder to be treated, symptom and combination thereof. For example, the other drug may be used in an amount of 0.01 to 100 parts by mass, based on 1 part by mass of the compound of the present disclosure. The other drug may be a combination of two or more kind of arbitrary drugs in a proper proportion.

[0090] The compounds described herein may be used or combined with one or more therapeutic agent such as an antimicrobial agent, an antiviral agent, a cytotoxic agent, a gene expression modulatory agent, a chemotherapeutic agent, an anti-cancer agent, an anti-angiogenic agent, an immunotherapeutic agent, an anti-hormonal agent, an anti-fibrotic agent, radiotherapy, a radiotherapeutic agent, an anti-neoplastic agent, and an anti-proliferation agent. These therapeutic agents may be in the forms of compounds, antibodies, polypeptides, or polynucleotides.

[0091] The compounds described herein may be used or combined with one or more of a therapeutic antibody, a bispecific antibody and “antibody-like” therapeutic protein (such as DARTs®, Duobodies®, Bites®, XmAbs®, TandAbs®, Fab derivatives), an antibody-drug conjugate (ADC), a virus, an oncolytic virus, gene modifiers or editors such as CRISPR (including CRISPR Cas9), zinc finger nucleases or synthetic nucleases (TALENs), a CAR (chimeric antigen receptor) T-cell immunotherapeutic agent, or any combination thereof.

[0092] Examples of chemotherapeutics include an alkylation agent, nitrosourea agent, antimetabolite, anticancer antibiotics, vegetable-origin alkaloid, topoisomerase inhibitor,



hormone drug, hormone antagonist, aromatase inhibitor, P-glycoprotein inhibitor, platinum complex derivative, other immunotherapeutic drugs and other anticancer drugs.

[0093] The compounds described herein may be used or combined with a cancer treatment adjunct, such as a leucopenia (neutropenia) treatment drug, thrombocytopenia treatment drug, antiemetic and cancer pain intervention drug, concomitantly or in a mixture form.

[0094] The compounds described herein may be used or combined with a kinase inhibitor.

[0095] In one embodiment, the compounds of the present disclosure can be used with other immunomodulators and/or a potentiating agent concomitantly or in a mixture form. Examples of the immunomodulator include various cytokines, vaccines and adjuvants. Examples of these cytokines, vaccines and adjuvants that stimulates immune responses include but not limited to GM-CSF, M-CSF, G-CSF, interferon- $\alpha$ ,  $\beta$ , or  $\gamma$ , IL-1, IL-2, IL-3, IL-12, Poly (I:C) and CPG. The potentiating agents include cyclophosphamide and analogs of cyclophosphamide, anti-TGF and imatinib (Gleevec), a mitosis inhibitor, such as paclitaxel, Sunitinib (Sutent) or other antiangiogenic agents, an aromatase inhibitor, such as letrozole, an A2a adenosine receptor (A2AR) antagonist, an angiogenesis inhibitor, anthracyclines, oxaliplatin, doxorubicin, TLR4 antagonists, and IL-18 antagonists.

[0096] In some embodiments, the compounds described herein may be used or combined with one or more modulator of CCR1, CCR2, CCR3, CCR4, CCR5, CCR6, CCR7, CCR8, CCR9, CCR10, CCR11, CXCR1, CXCR2, CXCR3, CXCR4, CXCR5, CXCR6, CXCR7, ChemR23, C5aR, C5a, and C5. In some embodiments, the modulator is an antagonist.

[0097] In some embodiments, the compounds described herein may be used or combined with one or more of CCX354, CCX9588, CCX140, CCX872, CCX598, CCX6239, CCX9664, CCX2553, CCX 2991, CCX282, CCX025, CCX507, CCX430, CCX765, CCX224, CCX662, CCX650, CCX832, CCX168, and CCX168-M1.

## **DOSAGE**

[0098] Dosage levels of the order of from about 0.1 mg to about 140 mg per kilogram of body weight per day are useful in the treatment or preventions of conditions involving the PD-1/PD-L1 interaction (about 0.5 mg to about 7 g per human patient per day). The amount of active

ingredient that may be combined with the carrier materials to produce a single dosage form will vary depending upon the host treated and the particular mode of administration. Dosage unit forms will generally contain between from about 1 mg to about 500 mg of an active ingredient. For compounds administered orally, transdermally, intravenously, or subcutaneously, it is  
5 preferred that sufficient amount of the compound be administered to achieve a serum concentration of 5 ng (nanograms)/mL-10 µg (micrograms)/mL serum, more preferably sufficient compound to achieve a serum concentration of 20 ng-1 µg/ml serum should be administered, most preferably sufficient compound to achieve a serum concentration of 50 ng/ml-200 ng/ml serum should be administered. For direct injection into the synovium (for the  
10 treatment of arthritis) sufficient compounds should be administered to achieve a local concentration of approximately 1 micromolar.

[0099] Frequency of dosage may also vary depending on the compound used and the particular disease treated. However, for treatment of most disorders, a dosage regimen of 4 times daily, three times daily, or less is preferred, with a dosage regimen of once daily or 2 times daily being  
15 particularly preferred. It will be understood, however, that the specific dose level for any particular patient will depend upon a variety of factors including the activity of the specific compound employed, the age, body weight, general health, sex, diet, time of administration, route of administration, and rate of excretion, drug combination (*i.e.*, other drugs being administered to the patient), the severity of the particular disease undergoing therapy, and other  
20 factors, including the judgment of the prescribing medical practitioner.

[0100] In another aspect of the disclosure, the compounds of the disclosure can be used in a variety of non-pharmaceutical *in vitro* and *in vivo* application. The compounds of the disclosure may also be used as positive controls in assays for PD-1/PD-L1 interaction activity, *i.e.*, as standards for determining the ability of a candidate agent to bind to PD-1 and/or PD-L1, or as  
25 radiotracers for positron emission tomography (PET) imaging or for single photon emission computerized tomography (SPECT).

[0101] Also within the scope of the present disclosure are kits comprising a compound of the present disclosure or pharmaceutically acceptable salts thereof and instructions for use. The kit can further contain at least one additional reagent. Kits typically include a label indicating the

intended use of the contents of the kit. The term label includes any writing, or recorded material supplied on or with the kit, or which otherwise accompanies the kit.

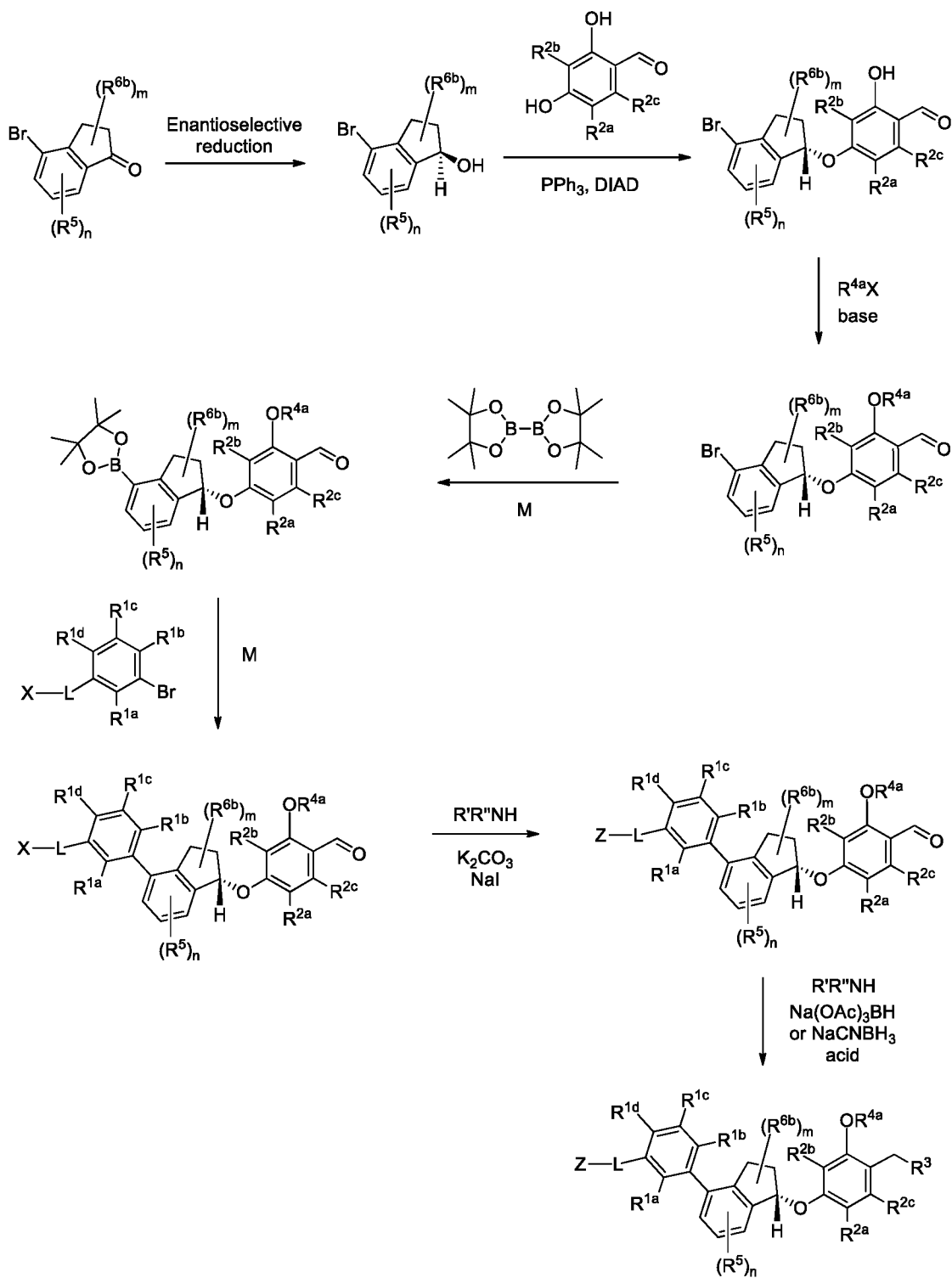
## GENERAL SYNTHETIC PROCEDURES

[0102] The embodiments are also directed to processes and intermediates useful for preparing the subject compounds or pharmaceutically acceptable salts thereof.

[0103] Exemplary chemical entities useful in methods of the embodiments will now be described by reference to illustrative synthetic schemes for their general preparation herein and the specific examples that follow. Artisans will recognize that, to obtain the various compounds herein, starting materials may be suitably selected so that the ultimately desired substituents will be carried through the reaction scheme with or without protection as appropriate to yield the desired product. Alternatively, it may be necessary or desirable to employ, in the place of the ultimately desired substituent, a suitable group that may be carried through the reaction scheme and replaced as appropriate with the desired substituent. Furthermore, one of skill in the art will recognize that the transformations shown in the schemes below may be performed in any order that is compatible with the functionality of the particular pendant groups.

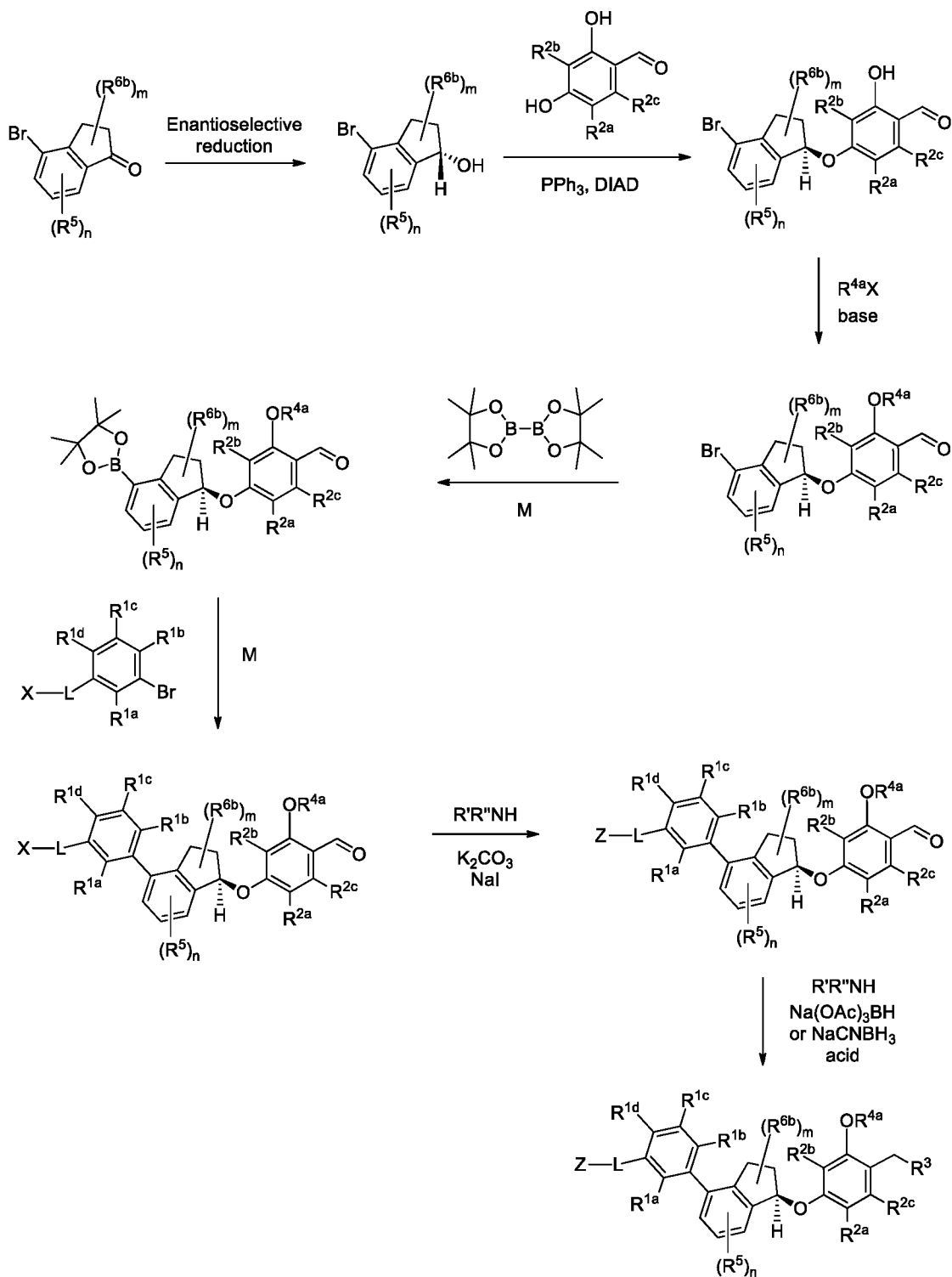
[0104] Representative syntheses of compounds of the present disclosure are described in the scheme below, and the particular examples that follow. Schemes 1 and 2 are provided as further embodiments of the disclosure and illustrate general methods which were used to prepare compounds of the present disclosure including compounds of Formula (I), (Ia), or (Ib), and which can be used to prepare additional compounds having the Formula (I), (Ia), or (Ib). The methodology is compatible with a wide variety of functionalities.

Scheme 1



- [0105] The 4-Bromoindanone compound can be enantioselectively reduced to its optically pure 4-bromoindanol derivative using a chiral reducing agent containing boron. In the subsequent step, the ether bond can be formed using reagents such as triphenyl phosphine and diisopropyl or diethyl azodicarboxylate (in this case, the reaction leads to an inversion of configuration, however, some racemization was observed). Alkylation of the phenol intermediate can be achieved using the appropriate alkyl halide or mesylate reagent. Introduction of the boronate at the 4-position of the indane ring can be accomplished *via* transition metal mediated coupling using bis(pinacolato)diboron. Coupling at the 4-position of the indane ring can be accomplished *via* transition metal mediated coupling using the appropriate aryl halide.
- 5
- 10 Displacement of the halide X with appropriate amine can be achieved using potassium or cesium carbonate in presence of metal bromide or metal iodide. The reductive amination can be accomplished using the appropriate primary or secondary amine and a reducing agent such as sodium cyanoborohydride or sodium triacetoxyborohydride in presence of a mild acid such as acetic acid. The amine group added in the reductive amination is shown as R<sup>3</sup> in the diagram
- 15 above. The transformations shown in Scheme 1 may be performed in any order that is compatible with the functionality of the particular pendant groups.

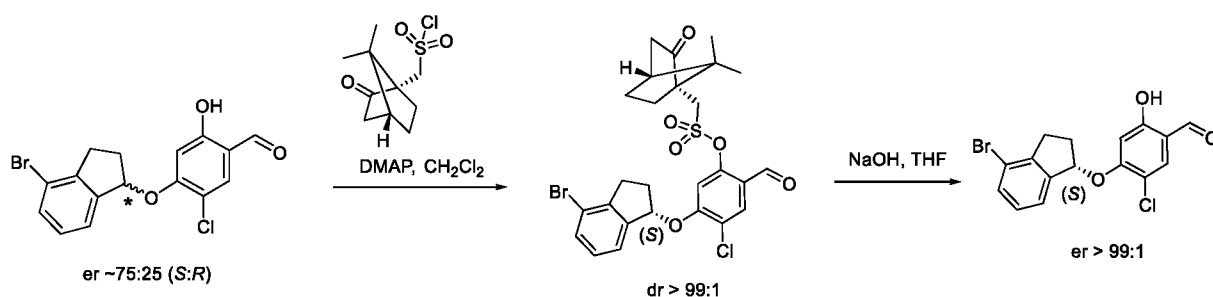
Scheme 2



[0106] The 4-Bromoindanone compound can be enantioselectively reduced to its optically pure 4-bromoindanol derivative using a chiral reducing agent containing boron. In the subsequent step, the ether bond can be formed using reagents such as triphenyl phosphine and diisopropyl or diethyl azodicarboxylate (in this case, the reaction leads to an inversion of configuration, however, some racemization was observed). Alkylation of the phenol intermediate can be achieved using the appropriate alkyl halide or mesylate reagent. Introduction of the boronate at the 4-position of the indane ring can be accomplished *via* transition metal mediated coupling using bis(pinacolato)diboron. Coupling at the 4-position of the indane ring can be accomplished *via* transition metal mediated coupling using the appropriate aryl halide.

Displacement of the halide X with appropriate amine can be achieved using potassium or cesium carbonate in presence of metal bromide or metal iodide. The reductive amination can be accomplished using the appropriate primary or secondary amine and a reducing agent such as sodium cyanoborohydride or sodium triacetoxyborohydride in presence of a mild acid such as acetic acid. The amine group added in the reductive amination is shown as R<sup>3</sup> in the diagram above. The transformations shown in Scheme 2 may be performed in any order that is compatible with the functionality of the particular pendant groups.

Scheme 3



[0107] As an example, enrichment of optical purity of chiral intermediates can be achieved as described in Scheme 3.

## EXAMPLES

[0108] The following Examples illustrate various methods of making compounds of this disclosure including compounds of Formula (I), (Ia), or (Ib). The following examples are offered to illustrate, but not to limit the claimed disclosure.

5 [0109] Reagents and solvents used below can be obtained from commercial sources such as Aldrich Chemical Co. (Milwaukee, Wisconsin, USA). <sup>1</sup>H-NMR spectra were recorded on a Varian Mercury 400 MHz NMR spectrometer. Significant peaks are provided relative to TMS and are tabulated in the order: multiplicity (s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet) and number of protons. Mass spectrometry results are reported as the ratio of mass  
10 over charge. In the examples, a single *m/z* value is reported for the M+H (or, as noted, M-H) ion containing the most common atomic isotopes. Isotope patterns correspond to the expected formula in all cases. Electrospray ionization (ESI) mass spectrometry analysis was conducted on a Hewlett-Packard MSD electrospray mass spectrometer using the HP1100 HPLC for sample delivery. Normally the analyte was dissolved in methanol or CH<sub>3</sub>CN at 0.1 mg/mL and 1  
15 microliter was infused with the delivery solvent into the mass spectrometer, which scanned from 100 to 1000 Daltons. All compounds could be analyzed in the positive or negative ESI mode, using acetonitrile / water with 1% formic acid as the delivery solvent.

[0110] The following abbreviations are used in the Examples and throughout the description of the disclosure: TLC means Thin layer chromatography.

20 [0111] Compounds within the scope of this disclosure can be synthesized as described below, using a variety of reactions known to the skilled artisan. One skilled in the art will also recognize that alternative methods may be employed to synthesize the target compounds of this disclosure, and that the approaches described within the body of this document are not exhaustive, but do provide broadly applicable and practical routes to compounds of interest.

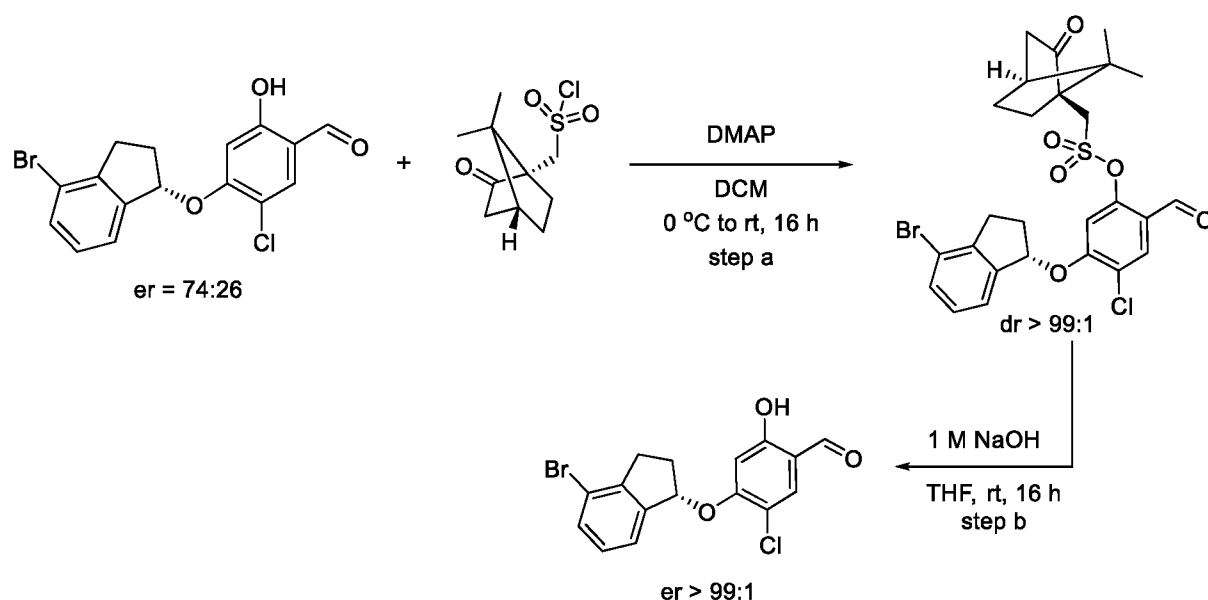
25 [0112] Certain molecules claimed in this patent can exist in different enantiomeric and diastereomeric forms and all such variants of these compounds are claimed unless a specific enantiomer is specified.



[0113] The detailed description of the experimental procedures used to synthesize key compounds in this text lead to molecules that are described by the physical data identifying them as well as by the structural depictions associated with them.

[0114] Those skilled in the art will also recognize that during standard work up procedures in organic chemistry, acids and bases are frequently used. Salts of the parent compounds are sometimes produced, if they possess the necessary intrinsic acidity or basicity, during the experimental procedures described within this patent.

### Synthesis of of (*S*)-4-((4-bromo-2,3-dihydro-1*H*-inden-1-yl)oxy)-5-chloro-2-hydroxybenzaldehyde

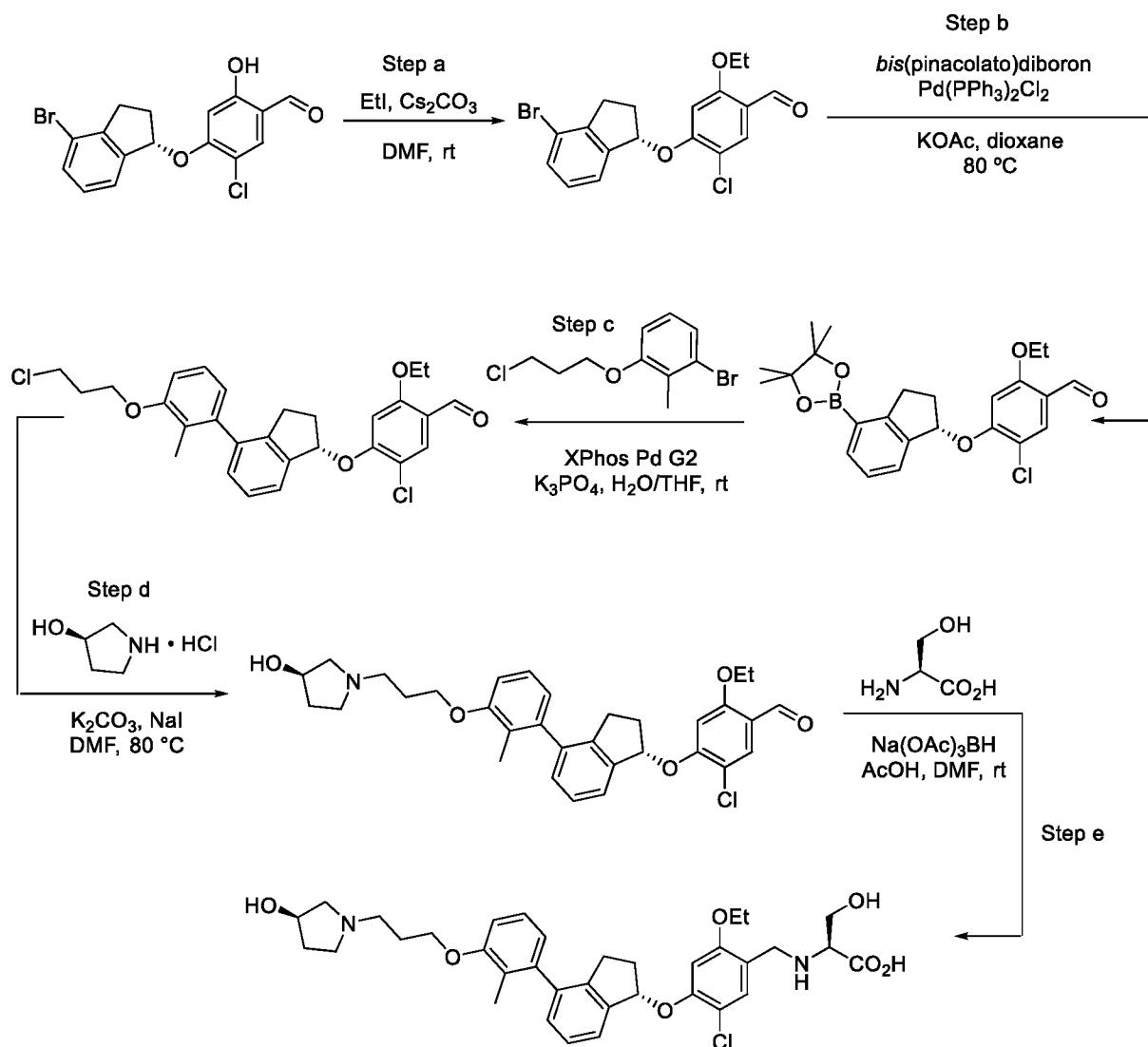


[0115] **Step a:** A chiral enriched sample of (*S*)-4-((4-bromo-2,3-dihydro-1*H*-inden-1-yl)oxy)-5-chloro-2-hydroxybenzaldehyde (40.0 g, 109 mmol, er = 74:26) was dissolved in dichloromethane (500 mL) at 0 °C and (1*S*)-(+)-10-camphorsulfonyl chloride (54.6 g, 218 mmol) and 4-dimethylpyridine (19.9 g, 163 mmol) were added. The reaction was allowed to warm to room temperature and stirred for 16 hours. A saturated aqueous solution of sodium bicarbonate (500 mL) was added to the solution and this was extracted with dichloromethane (3 x 250 mL). The combined organic layers were washed with aqueous hydrogen chloride (1M, 500 mL) and

saturated aqueous sodium chloride (500 mL), dried over sodium sulfate, filtered, and concentrated onto silica gel under reduced pressure. The desired diastereomer (14.7 g) eluted from 0% to 100 % hexanes in ethyl acetate using pressurized silica gel chromatography (ISCO 330 G column). The column was subsequently washed with 20 % methanol in dichloromethane to afford a crude mixture of diastereomers (32 g) that was dissolved in acetonitrile (350 mL). A solid precipitated from this solution overnight. The solid was filtered and the filtrate containing the desired diastereomer was concentrated under reduced pressure to afford additional desired diastereomer (7.3 g) of 5-(((*S*)-4-bromo-2,3-dihydro-1*H*-inden-1-yl)oxy)-4-chloro-2-formylphenyl ((1*S*,4*R*)-7,7-dimethyl-2-oxobicyclo[2.2.1]heptan-1-yl)methanesulfonate, dr > 99:1 by proton <sup>1</sup>H NMR. MS: (ES) *m/z* calculated for C<sub>26</sub>H<sub>26</sub>BrClO<sub>6</sub>SNa [M+Na]<sup>+</sup> 603.0, found 602.9. <sup>1</sup>H NMR (400 MHz, Chloroform-*d*) δ 10.16 (s, 1H), 7.97 (s, 1H), 7.55 – 7.47 (m, 1H), 7.45 – 7.38 (m, 1H), 7.28-7.25 (m, 1H), 7.16 (t, *J* = 7.5 Hz, 1H), 5.97 (t, *J* = 5.6 Hz, 1H), 3.95 (dd, *J* = 15.1, 1.7 Hz, 1H), 3.39 (dd, *J* = 14.9, 1.8 Hz, 1H), 3.29 – 3.13 (m, 1H), 2.99 (dt, *J* = 17.6, 7.1 Hz, 1H), 2.74 (dq, *J* = 14.5, 7.2 Hz, 1H), 2.57 – 2.39 (m, 2H), 2.34 – 2.24 (m, 1H), 2.23 – 2.06 (m, 2H), 2.07 – 1.96 (m, 2H), 1.87 – 1.75 (m, 1H), 1.15 (s, 3H), 0.94 (s, 3H).

**[0116] Step b:** 5-(((*S*)-4-bromo-2,3-dihydro-1*H*-inden-1-yl)oxy)-4-chloro-2-formylphenyl ((1*R*,4*R*)-7,7-dimethyl-2-oxobicyclo[2.2.1]heptan-1-yl)methanesulfonate (7.3, 12.5 mmol, dr > 99:1) was dissolved in tetrahydrofuran (100 mL) and aqueous sodium hydroxide (1M, 25.1 mmol) was added dropwise. The resultant solution was stirred at ambient temperature for 16 hours. Dichloromethane (500 mL) and water (500 mL) were then added to the stirred solution. The two layers were separated and the organic layer was washed with saturated aqueous ammonium chloride (250 mL) and saturated aqueous sodium chloride (250 mL), dried over sodium sulfate, filtered, and concentrated under reduced pressure to afford a white solid (4.3 g, 11.7 mmol, er > 99:1 by chiral HPLC determined using a RegisCell 250 x 4.6 mm column at a flow rate of 1.0 mL/min and an isocratic mobile phase of 1:1 hexanes/isopropanol, retention time: 6.0 min). MS: (ES) *m/z* calculated for C<sub>16</sub>H<sub>11</sub>BrClO<sub>3</sub> [M-H]<sup>-</sup> 365.0, found 365.0. <sup>1</sup>H NMR (400 MHz, Chloroform-*d*) δ 11.44 (s, 1H), 9.70 (s, 1H), 7.56 – 7.48 (m, 2H), 7.40 (d, *J* = 7.6 Hz, 1H), 7.16 (t, *J* = 7.8 Hz, 1H), 6.66 (s, *J* = 1.9 Hz, 1H), 5.88 (t, *J* = 5.7 Hz, 1H), 3.19 (dt, *J* = 15.3, 6.3 Hz, 1H), 2.98 (dt, *J* = 16.0, 7.2 Hz, 1H), 2.70 (dq, *J* = 13.8, 6.8 Hz, 1H), 2.25 (d, *J* = 8.6 Hz, 1H).

**Example 1: Synthesis of (5-chloro-2-ethoxy-4-(((*S*)-4-(3-(3-((*R*)-3-hydroxypyrrolidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)benzyl)-*L*-serine**



- 5 [0117] Step a: To a solution of (*S*)-4-((4-bromo-2,3-dihydro-1*H*-inden-1-yl)oxy)-5-chloro-2-hydroxybenzaldehyde (400 mg, 1.1 mmol) in DMF (5 mL) was added iodoethane (176  $\mu\text{L}$ , 2.186 mmol) followed by  $\text{Cs}_2\text{CO}_3$  (1.07 g, 3.3 mmol). The resulting suspension was then stirred at room temperature for 2 h. The reaction mixture was diluted with EtOAc (20 mL), washed with water (20 mL), saturated  $\text{NH}_4\text{Cl}$  solution (20 mL), dried ( $\text{MgSO}_4$ ), concentrated *in vacuo* to
- 10 obtain (*S*)-4-((4-bromo-2,3-dihydro-1*H*-inden-1-yl)oxy)-5-chloro-2-ethoxybenzaldehyde which was used as such in the next step.

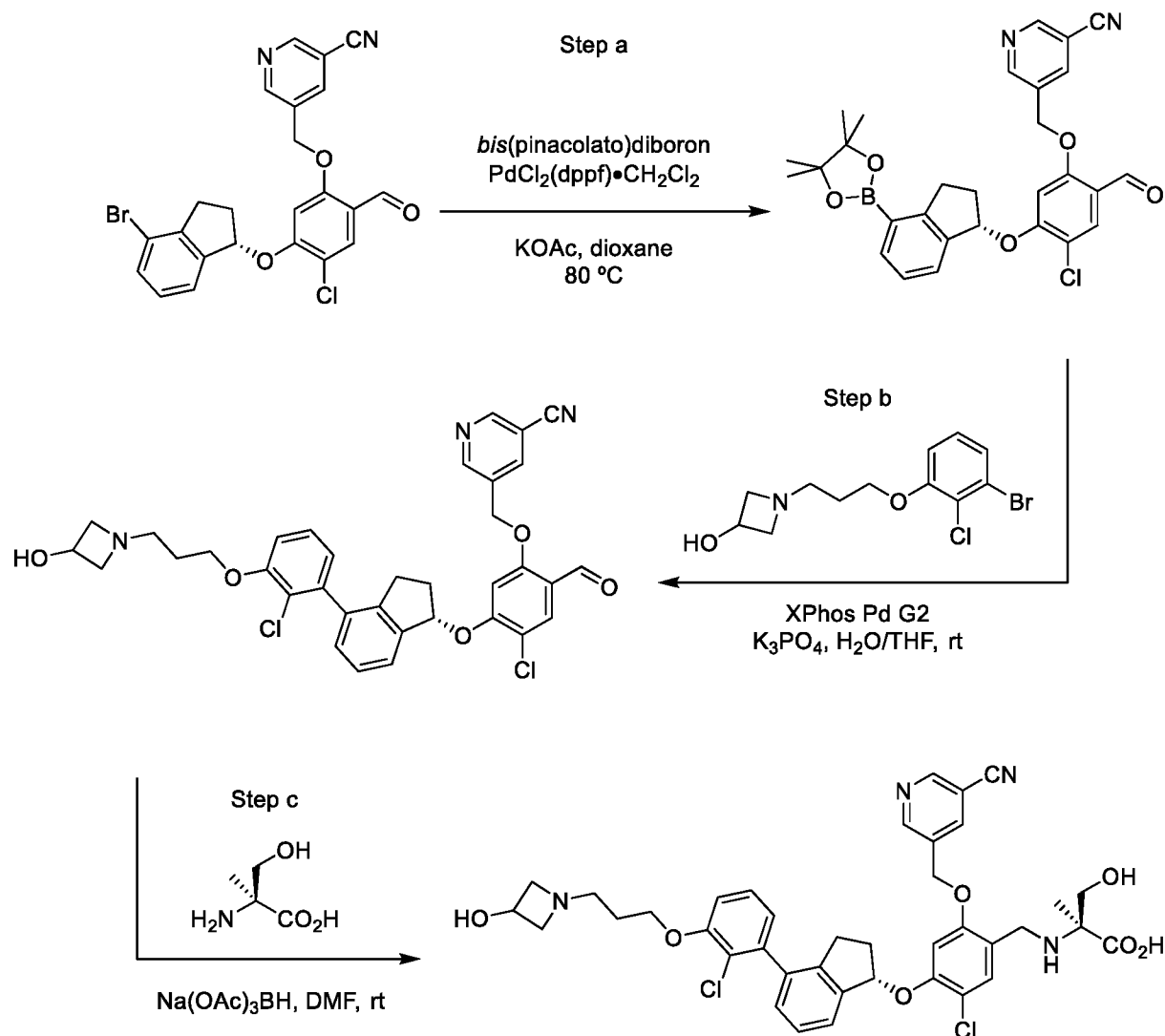
[0118] Step b: A solution of (*S*)-4-((4-bromo-2,3-dihydro-1*H*-inden-1-yl)oxy)-5-chloro-2-ethoxybenzaldehyde (417 mg, 1.06 mmol), bis(pinacolato)diboron (323 mg, 1.27 mmol), and potassium acetate (312 mg, 3.18 mmol) in 1,4-dioxane (10 mL) was degassed with nitrogen for 2 minutes before the addition of Bis(triphenylphosphine)palladium(II) dichloride (75 mg, 0.106 mmol). The mixture was degassed further for 2 minutes and then heated to 80 °C. After 11 h, the solution was cooled to room temperature and water was added (50 mL). The reaction mixture was extracted with EtOAc (30 mL x 3) and the combined organics were dried over Na<sub>2</sub>SO<sub>4</sub>, filtered, and concentrated in vacuo. Purification of the crude material by flash chromatography (SiO<sub>2</sub>, 100% hexane to 20% EtOAc in hexane) gave (*S*)-5-chloro-2-ethoxy-4-(((4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-2,3-dihydro-1*H*-inden-1-yl)oxy)benzaldehyde.

[0119] Step c: A solution of (*S*)-5-chloro-2-ethoxy-4-(((4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-2,3-dihydro-1*H*-inden-1-yl)oxy)benzaldehyde (310 mg, 0.7 mmol), 1-bromo-3-(3-chloropropoxy)-2-methylbenzene (226 mg, 0.91 mmol), and aqueous 0.5 M K<sub>3</sub>PO<sub>4</sub> (5 mL) in THF (5 mL) was degassed with nitrogen for 2 minutes before XPhos Pd G2 (17 mg, 0.021 mmol) was added. After degassing for an additional 1 minute, the solution was allowed to stir at room temperature for 12 h. Water (20 mL) was then added to the reaction mixture, and the mixture was extracted with EtOAc (20 mL x 2). The combined organics were dried over Na<sub>2</sub>SO<sub>4</sub>, filtered, and concentrated *in vacuo*. Purification of the crude material by flash chromatography (SiO<sub>2</sub>, 100% hexanes to 50% EtOAc in hexanes) gave (*S*)-5-chloro-4-(((3-(3-chloropropoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-ethoxybenzaldehyde.

[0120] Step d: To a slurry of (*S*)-5-chloro-4-(((3-(3-chloropropoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-ethoxybenzaldehyde (200 mg, 0.4 mmol) and potassium carbonate (166 mg, 1.2 mmol) in DMF (6 mL) was added NaI (90 mg, 0.6 mmol) and (*R*)-pyrrolidin-3-ol hydrochloride salt (105 mg, 1.2 mmol) and the resulting reaction mixture was stirred overnight at 80 °C. EtOAc (20 mL) and 0.2 N aqueous HCl solution (20 mL) were added to the reaction mixture after cooling it down to room temperature and the aqueous layer was extracted with 2:1 CHCl<sub>3</sub>/IPA (20 mL). Combined organic layers were dried (Na<sub>2</sub>SO<sub>4</sub>), and concentrated *in vacuo* to obtain 5-chloro-2-ethoxy-4-(((*S*)-4-(3-(3-((*R*)-3-hydroxypyrrolidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)benzaldehyde which was used as such in the next step.

[0121] Step e: A suspension of 5-chloro-2-ethoxy-4-(((*S*)-4-(3-(3-((*R*)-3-hydroxypyrrolidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)benzaldehyde (60 mg, 0.11 mmol), AcOH (100  $\mu$ L) and *L*-serine (100 mg, 0.95 mmol) was stirred in DMF (1.5 mL) for 10 minutes before sodium triacetoxyborohydride (100 mg, 0.47 mmol) was added. The reaction mixture was left to stir overnight at room temperature. The reaction mixture was filtered through syringe filter and the crude material was purified by reverse phase preparative HPLC (CH<sub>3</sub>CN–H<sub>2</sub>O with 0.1% TFA) to obtain ((5-chloro-2-ethoxy-4-(((*S*)-4-(3-(3-((*R*)-3-hydroxypyrrolidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)benzyl)-*L*-serine. MS: (ES) *m/z* calculated for C<sub>35</sub>H<sub>44</sub>ClN<sub>2</sub>O<sub>7</sub> [M+H]<sup>+</sup> 639.2, found 639.2. <sup>1</sup>H NMR (400 MHz, Methanol-*d*<sub>4</sub>)  $\delta$  7.44 – 7.15 (m, 4H), 7.14 – 7.07 (m, 1H), 6.94 (d, *J* = 9.3 Hz, 2H), 6.77 (dd, *J* = 24.3, 7.7 Hz, 1H), 5.98 (d, *J* = 9.8 Hz, 1H), 4.62 – 4.52 (m, 1H), 4.34 – 4.08 (m, 6H), 4.02 (dd, *J* = 11.8, 3.9 Hz, 1H), 3.86 (dd, *J* = 11.8, 7.0 Hz, 1H), 3.67 – 3.49 (m, 2H), 3.43 (dd, *J* = 18.2, 10.9 Hz, 4H), 3.27 (d, *J* = 12.2 Hz, 1H), 2.93 – 2.73 (m, 3H), 2.69 – 2.47 (m, 3H), 2.28 (qq, *J* = 9.2, 5.0, 4.0 Hz, 3H), 2.19 – 1.94 (m, 5H), 1.55 – 1.43 (m, 3H).

**Example 2: Synthesis of (*S*)-2-((5-chloro-4-(((*S*)-4-(2-chloro-3-(3-(3-hydroxyazetidin-1-yl)propoxy)phenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-((5-cyanopyridin-3-yl)methoxy)benzyl)amino)-3-hydroxy-2-methylpropanoic acid**



- [0122] Step a: A solution of 5-[[5-[(1*S*)-4-bromoindan-1-yl]oxy-4-chloro-2-formyl-phenoxy]methyl]pyridine-3-carbonitrile (3.0 g, 6.2 mmol), *bis*(pinacolato)diboron (2.37 g, 9.3 mmol), and potassium acetate (1.83 g, 18.6 mmol) in dioxane (100 mL) was degassed with nitrogen for 15 min before the addition of 1,1'-*bis*(diphenylphosphino)ferrocene]-dichloropalladium(II) complexed with dichloromethane. The mixture was degassed further for 5 min and then heated to 80 °C. After 11 h, the solution was cooled to room temperature and water was added (50 mL). The reaction mixture was extracted with EtOAc (30 mL x 3) and the combined organics were dried over  $\text{MgSO}_4$ , filtered, and concentrated *in vacuo*. Purification of the crude material by flash chromatography ( $\text{SiO}_2$ , 100% hexane to 50% EtOAc in hexane) gave

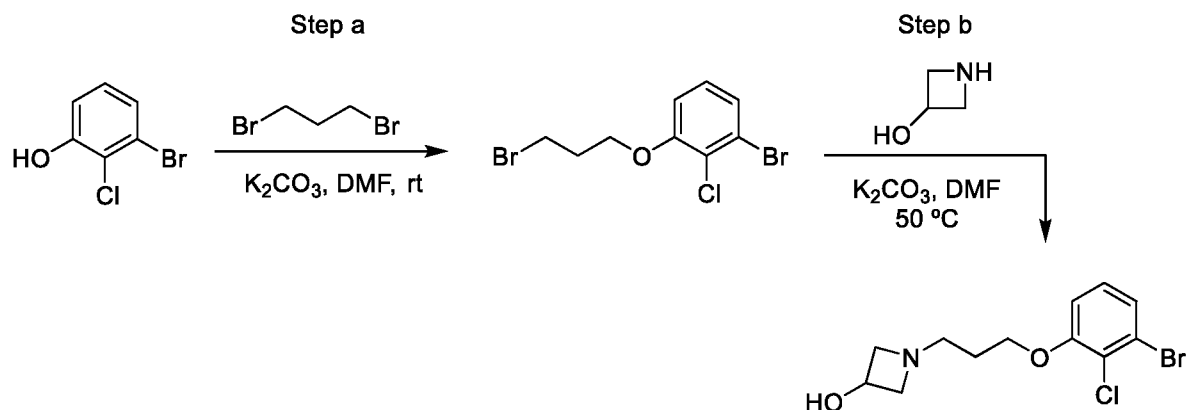
(*S*)-5-((4-chloro-2-formyl-5-((4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-2,3-dihydro-1*H*-inden-1-yl)oxy)phenoxy)methyl)nicotinonitrile.

**[0123]** Step b: A solution of (*S*)-5-((4-chloro-2-formyl-5-((4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-2,3-dihydro-1*H*-inden-1-yl)oxy)phenoxy)methyl)nicotinonitrile (2.5 g, 4.68 mmol), 1-(3-(3-bromo-2-chlorophenoxy)propyl)azetidin-3-ol (1.5 g, 4.68 mmol), and aqueous 0.5 M K<sub>3</sub>PO<sub>4</sub> (28 mL, 14 mmol) in THF (30 mL) was degassed with nitrogen for 25 min before XPhos Pd G2 (0.74 g, 0.94 mmol) was added. After degassing for an additional 10 min, the solution was allowed to stir at room temperature for 20 h. Water (30 mL) was then added to the reaction mixture, and the mixture was extracted with 2:1 chloroform: isopropanol (40 mL x 3).

The combined organics were dried over MgSO<sub>4</sub>, filtered, and concentrated *in vacuo*. Purification of the crude material by flash chromatography (SiO<sub>2</sub>, 100% DCM to 15% MeOH in DCM) gave (*S*)-5-((4-chloro-5-((4-(2-chloro-3-(3-(3-hydroxyazetidin-1-yl)propoxy)phenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-formylphenoxy)methyl)nicotinonitrile.

**[0124]** Step c: A solution of (*S*)-5-((4-chloro-5-((4-(2-chloro-3-(3-(3-hydroxyazetidin-1-yl)propoxy)phenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-formylphenoxy)methyl)nicotinonitrile (0.73 g, 1.1 mmol) and 2-Me-*L*-serine (0.40 g, 3.4 mmol) was stirred in DMF (36 mL) for 1 h before sodium triacetoxyborohydride (0.72 g, 3.4 mmol) was added in small portions over 1 h. The reaction mixture was left to stir overnight at room temperature. The majority of DMF was removed *in vacuo* and the crude material was purified by reverse phase preparative HPLC (CH<sub>3</sub>CN–H<sub>2</sub>O with 0.1% NH<sub>4</sub>HCO<sub>3</sub>) to obtain (*S*)-2-((5-chloro-4-(((*S*)-4-(2-chloro-3-(3-(3-hydroxyazetidin-1-yl)propoxy)phenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-((5-cyanopyridin-3-yl)methoxy)benzyl)amino)-3-hydroxy-2-methylpropanoic acid. MS: (ES) *m/z* calculated for C<sub>39</sub>H<sub>40</sub>Cl<sub>2</sub>N<sub>4</sub>O<sub>7</sub> [M+H]<sup>+</sup> 747.2, found 747.2. <sup>1</sup>H NMR (400 MHz, Methanol-*d*<sub>4</sub>) δ 8.98 (s, 1H), 8.87 (d, *J* = 1.9 Hz, 1H), 8.43 (s, 1H), 7.45 (s, 1H), 7.39 – 7.21 (m, 3H), 7.16 (d, *J* = 7.4 Hz, 1H), 7.08 (d, *J* = 9.2 Hz, 1H), 7.02 – 6.79 (m, 2H), 6.04 – 5.81 (m, 1H), 5.32 (s, 2H), 4.34 (q, *J* = 6.4 Hz, 1H), 4.12 (t, *J* = 6.0 Hz, 2H), 3.84 (s, 2H), 3.69 (td, *J* = 6.3, 2.3 Hz, 3H), 3.62 (d, *J* = 11.2 Hz, 1H), 3.01 – 2.79 (m, 1H), 2.92 (td, *J* = 6.5, 2.1 Hz, 2H), 2.75 (t, *J* = 7.4 Hz, 2H), 2.70 – 2.54 (m, 1H), 2.53 – 2.39 (m, 1H), 2.18 – 2.01 (m, 1H), 1.91 (q, *J* = 6.5 Hz, 2H), 1.29 (s, 3H).

### Synthesis of 1-(3-(3-bromo-2-chlorophenoxy)propyl)azetidin-3-ol

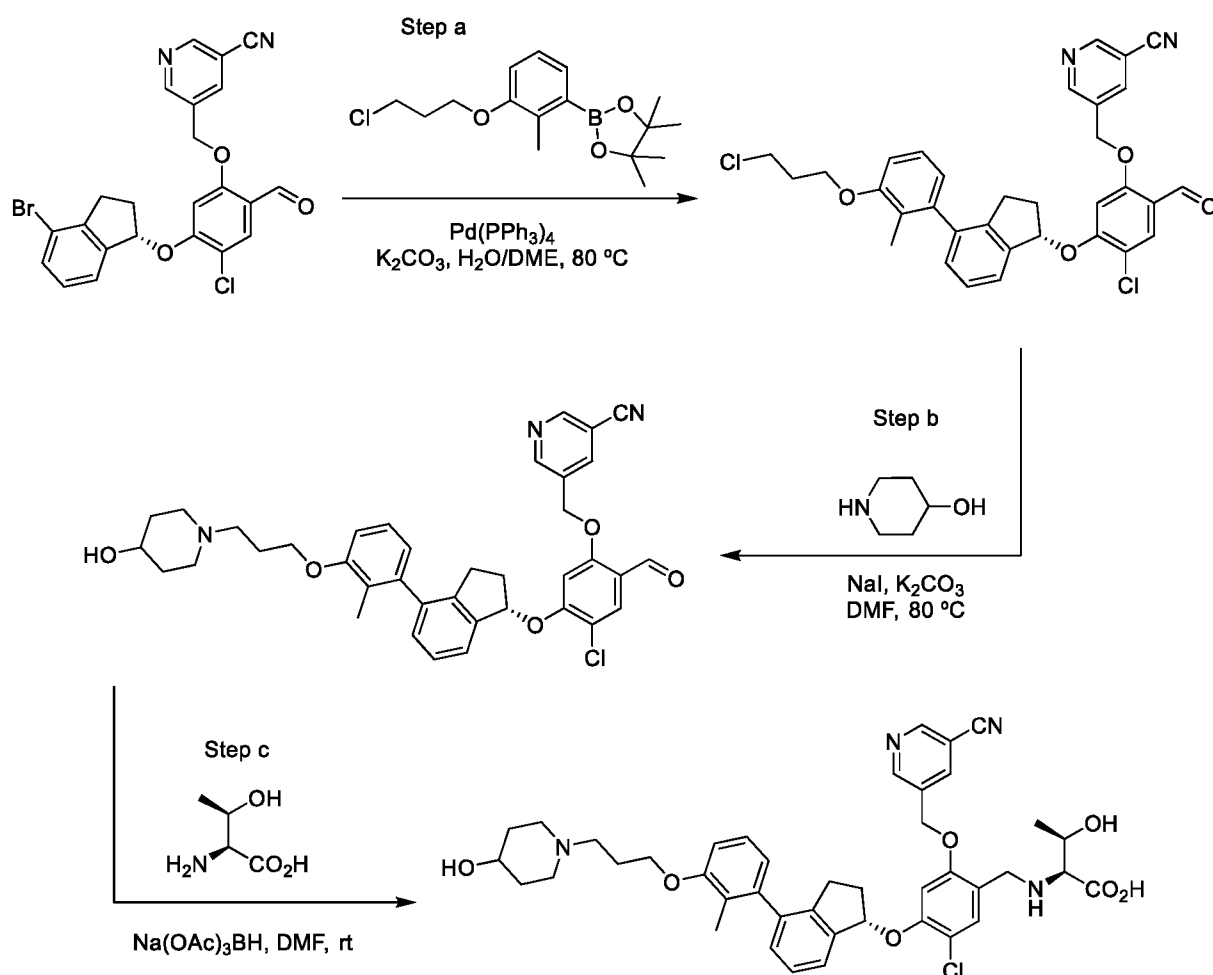


[0125] Step a: To a slurry of 3-bromo-2-chlorophenol (9.82 g, 47.3 mmol) and potassium carbonate (13.7 g, 94.6 mmol) in DMF (20 mL) was slowly added 1,3-dibromopropane (28.7 g, 142 mmol) and the mixture was stirred at room temperature for 18 h. Water (30 mL) and DCM (50 mL) were added to the reaction mixture and after stirring for a few minutes, the biphasic solution was poured into a separatory funnel. The organic layer was separated and the aqueous layer was re-extracted with DCM (2 x 50 mL). The combined organics were dried over  $MgSO_4$ , filtered, and concentrated *in vacuo*. The crude material was purified by flash chromatography ( $SiO_2$ , 100% hexane to 5%  $Et_2O$  in hexane) to obtain 1-bromo-3-(3-bromopropoxy)-2-chlorobenzene.

[0126] Step b: To a slurry of 1-bromo-3-(3-bromopropoxy)-2-chlorobenzene (3.7 g, 11.3 mmol) and potassium carbonate (3.12 g, 22.6 mmol) in DMF (10 mL) at 50 °C was added a pre-heated (50 °C) solution of finely suspended 3-hydroxyazetidine (1.07 g, 14.6 mmol) in DMF (25 mL). After 1 h, the reaction mixture was allowed to cool to room temperature and filtered through Celite. The filtrate was concentrated *in vacuo* and the crude material was purified by flash chromatography ( $SiO_2$ , 10% to 20%  $Et_2O$  in hexane then 10% MeOH in DCM) to obtain 1-(3-(3-bromo-2-chlorophenoxy)propyl)azetidin-3-ol.



**Example 3: Synthesis of (5-chloro-2-((5-cyanopyridin-3-yl)methoxy)-4-(((S)-4-(3-(4-hydroxypiperidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1H-inden-1-yl)oxy)benzyl)-L-threonine**



5

[0127] Step a: A biphasic solution of 5-[[5-[(1S)-4-bromoindan-1-yl]oxy-4-chloro-2-formylphenoxy]methyl]pyridine-3-carbonitrile (7.7 g, 16 mmol), 2-(3-(3-chloropropoxy)-2-methylphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (6.0 g, 19 mmol), and  $\text{Pd(PPh}_3)_4$  (3.7 g, 32 mmol) in aqueous 2 M  $\text{K}_2\text{CO}_3$  (24 mL, 48 mmol) and 1,2-dimethoxyethane (240 mL) was degassed with nitrogen for 20 min. The mixture was then heated to  $80^\circ\text{C}$  for 8 h before it was cooled to rt and water (150 mL) was added. The organic layer was separated and the aqueous layer was re-extracted with EtOAc (75 mL x 2). The organics were combined, dried over  $\text{MgSO}_4$ , filtered, and concentrated *in vacuo*. Purification of the crude material by flash

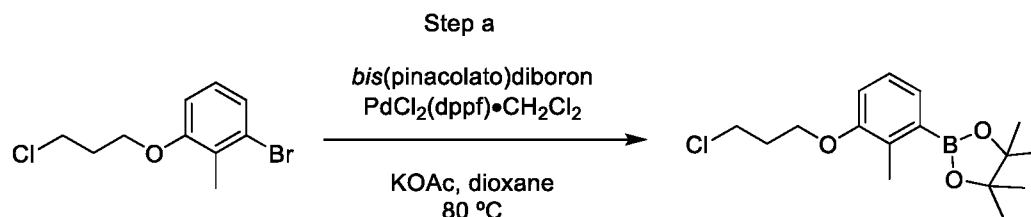
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chromatography (SiO<sub>2</sub>, 100% hexane to 50% EtOAc in hexane) gave (*S*)-5-((4-chloro-5-((4-(3-(3-chloropropoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-formylphenoxy)methyl)nicotinonitrile.

[0128] Step b: A slurry of (*S*)-5-((4-chloro-5-((4-(3-(3-chloropropoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-formylphenoxy)methyl)nicotinonitrile (7.3 g, 12.4 mmol), 4-hydroxypiperidine (1.9 g, 18.6 mmol), sodium iodide (0.56 g, 3.72 mmol), and K<sub>2</sub>CO<sub>3</sub> (3.4 g, 24.8 mmol) was heated to 80 °C and allowed to stir at this temperature for 8 h. After cooling to rt, the reaction mixture was poured into a separatory funnel containing water (100 mL). The mixture was extracted with 2:1 CHCl<sub>3</sub>:isopropanol (60 mL x 3). The organics were combined, dried over MgSO<sub>4</sub>, filtered, and concentrated *in vacuo*. Purification of the crude material by flash chromatography (SiO<sub>2</sub>, 100% DCM to 15% MeOH in DCM) gave (*S*)-5-((4-chloro-2-formyl-5-((4-(3-(3-(4-hydroxypiperidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)phenoxy)methyl)nicotinonitrile.

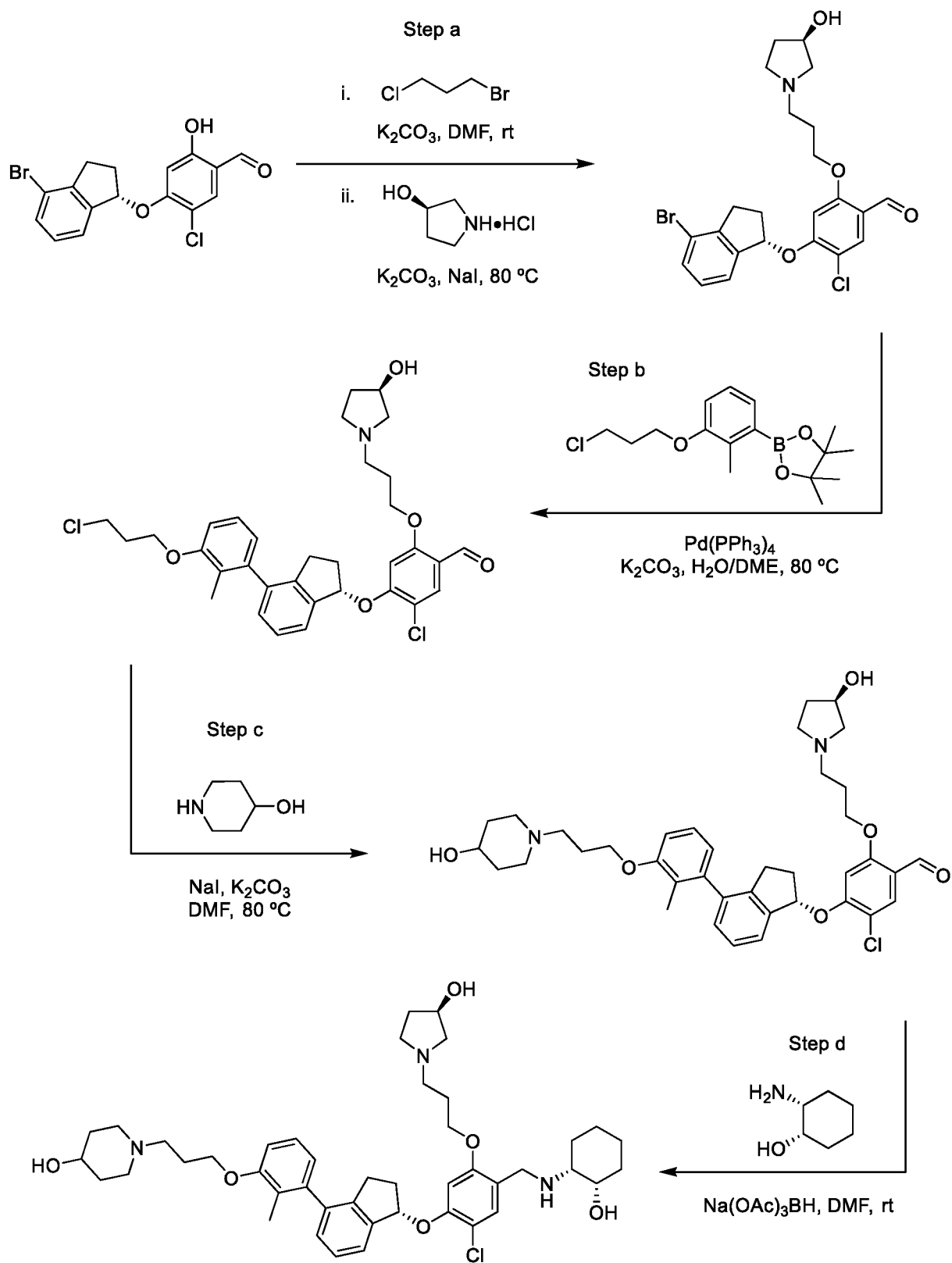
[0129] Step c: A solution of (*S*)-5-((4-chloro-2-formyl-5-((4-(3-(3-(4-hydroxypiperidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)phenoxy)methyl)nicotinonitrile (3.2 g, 4.9 mmol) and *L*-threonine (1.5 g, 12.2 mmol) was stirred in DMF (48 mL) for 3 h before sodium triacetoxyborohydride (3.1 g, 14.6 mmol) was added in portions over 10 min. The reaction mixture was left to stir overnight at room temperature. The majority of DMF was removed *in vacuo*, and the crude material was re-diluted in MeOH and filtered. The filtrate was purified by reverse phase preparative HPLC (CH<sub>3</sub>CN–H<sub>2</sub>O with 0.1% NH<sub>4</sub>HCO<sub>3</sub>) to obtain (5-chloro-2-((5-cyanopyridin-3-yl)methoxy)-4-(((*S*)-4-(3-(3-(4-hydroxypiperidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)benzyl)-*L*-threonine. MS: (ES) *m/z* calculated for C<sub>42</sub>H<sub>47</sub>ClN<sub>4</sub>O<sub>7</sub> [M+H]<sup>+</sup> 755.3, found 755.2. <sup>1</sup>H NMR (400 MHz, Methanol-*d*<sub>4</sub>) δ 8.97 (d, *J* = 2.1 Hz, 1H), 8.87 (d, *J* = 1.9 Hz, 1H), 8.41 (t, *J* = 2.1 Hz, 1H), 7.38 (s, 1H), 7.35 – 7.22 (m, 2H), 7.21 – 7.06 (m, 2H), 6.97 – 6.87 (m, 2H), 6.73 (dd, *J* = 24.8, 7.5 Hz, 1H), 5.97 – 5.80 (m, 1H), 5.30 (s, 2H), 4.07 (t, *J* = 6.0 Hz, 2H), 3.85 – 3.77 (m, 1H), 3.77 – 3.55 (m, 3H), 2.95 (d, *J* = 6.3 Hz, 1H), 2.92 – 2.74 (m, 2H), 2.69 – 2.57 (m, 3H), 2.55 – 2.36 (m, 1H), 2.31 – 1.99 (m, 4H), 1.96 (d, *J* = 18.4 Hz, 2H), 1.91 – 1.81 (m, 2H), 1.65 – 1.53 (m, 2H), 1.44 (s, 1H), 1.28 (d, *J* = 1.5 Hz, 2H), 1.20 (d, *J* = 6.3 Hz, 3H).

**Synthesis of 2-(3-(3-chloropropoxy)-2-methylphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane**



[0130] Step a: To a solution of 1-bromo-3-(3-chloropropoxy)-2-methylbenzene (5.0 g, 19 mmol), *bis*(pinacolato)diboron (4.8 g, 19 mmol) in dioxane (20 mL) was added potassium acetate (5.6 g, 57 mmol) and the mixture was degassed with nitrogen for 10 min. The catalyst 1,1'-*bis*(diphenylphosphino)ferrocene]dichloropalladium(II) complexed with dichloromethane (1.5 g, 1.9 mmol) was added, and the mixture was degassed for an additional 10 min before it was heated to 80 °C and left to stir at that temperature for 18 h. After cooling to rt, water (30 mL) was added to the reaction mixture. The aqueous layer was re-extracted with EtOAc (2 x 20 mL) and the combined organics were dried over  $\text{MgSO}_4$ , filtered, and concentrated *in vacuo*. The crude material was purified by flash chromatography ( $\text{SiO}_2$ , 100% hexane to 10% EtOAc in hexane) to obtain 2-(3-(3-chloropropoxy)-2-methylphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane.

**Example 4: Synthesis of 1-(3-(3-((*S*)-1-(2-chloro-4-(((1*R*,2*S*)-2-hydroxycyclohexyl)amino)methyl)-5-(3-((*R*)-3-hydroxypyrrolidin-1-yl)propoxy)phenoxy)-2,3-dihydro-1*H*-inden-4-yl)-2-methylphenoxy)propyl)piperidin-4-ol**



[0131] Step a: To a solution of 4-[(1*S*)-4-bromoindan-1-yl]oxy-5-chloro-2-hydroxy-benzaldehyde (545 mg, 1.48 mmol) in DMF (5 mL) was added K<sub>2</sub>CO<sub>3</sub> (614 mg, 4.44 mmol) and 1-bromo-3-chloropropane (257 mg, 1.63 mmol), and the resulting suspension was left to stir at rt for 18 h. (*R*)-(-)-3-pyrrolidinol hydrochloride (275 mg, 2.22 mmol), sodium iodide (45 mg, 0.30 mmol) and additional K<sub>2</sub>CO<sub>3</sub> (204 mg, 1.48 mmol) were added and the reaction mixture was heated to 80 °C and stirred for 18 h. After cooling to rt, the reaction was quenched with water and the mixture was extracted with EtOAc (20 mL) and 2:1 CHCl<sub>3</sub>:IPA (2 x 20 mL). The combined organic layers were dried over MgSO<sub>4</sub>, filtered, and concentrated *in vacuo*. The crude material was purified by flash chromatography (SiO<sub>2</sub>, 10% MeOH in DCM) to obtain 4-(((*S*)-4-bromo-2,3-dihydro-1*H*-inden-1-yl)oxy)-5-chloro-2-(3-((*R*)-3-hydroxypyrrolidin-1-yl)propoxy)benzaldehyde.

[0132] Step b: A biphasic solution of 4-(((*S*)-4-bromo-2,3-dihydro-1*H*-inden-1-yl)oxy)-5-chloro-2-(3-((*R*)-3-hydroxypyrrolidin-1-yl)propoxy)benzaldehyde (217 mg, 0.438 mmol), 2-(3-(3-chloropropoxy)-2-methylphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (219 mg, 0.658 mmol), and Pd(PPh<sub>3</sub>)<sub>4</sub> (76 mg, 0.066 mmol) in aqueous 2 M K<sub>2</sub>CO<sub>3</sub> (0.70 mL, 1.3 mmol) and 1,2-dimethoxyethane (6 mL) was degassed for 10 min before the mixture was heated to 90 °C. After 2 h, the mixture was cooled to rt and extracted with EtOAc (2 x 20 mL). The combined organic layers were dried over MgSO<sub>4</sub>, filtered, and concentrated *in vacuo*. The crude material was purified by flash chromatography (SiO<sub>2</sub>, 10% MeOH in DCM) to obtain 5-chloro-4-(((*S*)-4-(3-(3-chloropropoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-(3-((*R*)-3-hydroxypyrrolidin-1-yl)propoxy)benzaldehyde.

[0133] Step c: A slurry of 5-chloro-4-(((*S*)-4-(3-(3-chloropropoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-(3-((*R*)-3-hydroxypyrrolidin-1-yl)propoxy)benzaldehyde (70 mg, 0.12 mmol), 4-hydroxypiperidine (18 mg, 0.18 mmol), sodium iodide (6 mg, 0.036 mmol), and K<sub>2</sub>CO<sub>3</sub> (33 mg, 0.24 mmol) in DMF (23 mL) was heated to 80 °C and allowed to stir at this temperature overnight. After cooling to rt, the reaction mixture was concentrated *in vacuo*, and the crude residue was re-diluted in MeOH and filtered through a 0.45 µM syringe filter. The crude filtrate was purified by reverse phase preparative HPLC (CH<sub>3</sub>CN–H<sub>2</sub>O with 0.1% TFA) to obtain 5-chloro-4-(((*S*)-4-(3-(3-(4-hydroxypiperidin-1-yl)propoxy)-2-methylphenyl)-2,3-

dihydro-1*H*-inden-1-yl)oxy)-2-(3-((*R*)-3-hydroxypyrrolidin-1-yl)propoxy)benzaldehyde as a trifluoroacetate salt.

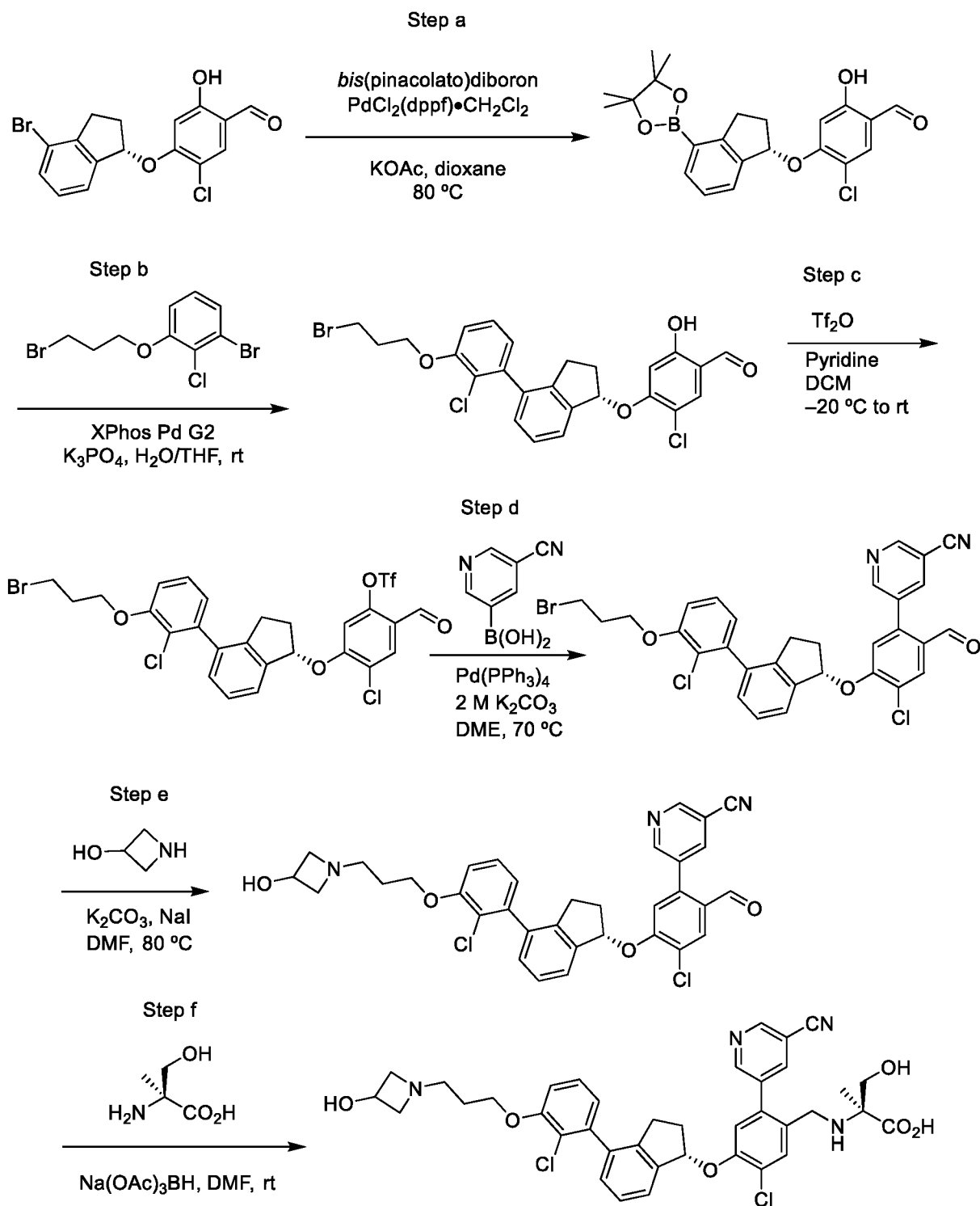
**[0134]** Step d: To a solution of 5-chloro-4-(((*S*)-4-(3-(3-(4-hydroxypiperidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-(3-((*R*)-3-hydroxypyrrolidin-1-

5 yl)propoxy)benzaldehyde (20 mg, 0.023 mmol) and (1*S*,2*R*)-2-aminocyclohexan-1-ol (11 mg, 0.093 mmol) in DMF (2 mL) was added two drops of acetic acid, and the reaction mixture was stirred at rt. After 2 h, Na(OAc)<sub>3</sub>BH (20 mg, 0.093 mmol) was added and the reaction was left to stir overnight. The reaction mixture was concentrated *in vacuo*, and the crude residue was re-

10 diluted in MeOH and passed through a 0.45 μM syringe filter. The crude filtrate was purified by reverse phase preparative HPLC (CH<sub>3</sub>CN–H<sub>2</sub>O with 0.1% TFA) to obtain 1-(3-(3-((*S*)-1-(2-chloro-4-(((1*R*,2*S*)-2-hydroxycyclohexyl)amino)methyl)-5-(3-((*R*)-3-hydroxypyrrolidin-1-

15 yl)propoxy)phenoxy)-2,3-dihydro-1*H*-inden-4-yl)-2-methylphenoxy)propyl)piperidin-4-ol as a trifluoroacetate salt. MS: (ES) *m/z* calculated for C<sub>44</sub>H<sub>60</sub>ClN<sub>3</sub>O<sub>6</sub> [M+H]<sup>+</sup> 762.4, found 762.3. <sup>1</sup>H NMR (400 MHz, Methanol-*d*<sub>4</sub>) δ 7.47 (s, 1H), 7.43 – 7.33 (m, 1H), 7.33 – 7.24 (m, 1H), 7.24 – 7.16 (m, 1H), 7.12 (d, *J* = 7.4 Hz, 1H), 7.02 (d, *J* = 13.1 Hz, 1H), 6.95 (d, *J* = 8.3 Hz, 1H), 6.83 – 6.70 (m, 1H), 6.06 – 5.97 (m, 1H), 4.63 – 4.55 (m, 2H), 4.39 – 4.19 (m, 5H), 4.19 – 3.99 (m, 5H), 3.93 – 3.73 (m, 2H), 3.71 – 3.52 (m, 3H), 3.51 – 3.34 (m, 3H), 3.23 – 3.01 (m, 1H), 3.00 – 2.76 (m, 1H), 2.76 – 2.48 (m, 2H), 2.44 – 2.21 (m, 5H), 2.21 – 2.06 (m, 3H), 2.06 – 1.89 (m, 8H), 1.89 – 1.76 (m, 2H), 1.76 – 1.54 (m, 3H), 1.53 – 1.28 (m, 2H).

20 **Example 5: Synthesis of (*S*)-2-((5-chloro-4-(((*S*)-4-(2-chloro-3-(3-(3-hydroxyazetidin-1-yl)propoxy)phenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-(5-cyanopyridin-3-yl)benzyl)amino) 3-hydroxy-2-methylpropanoic acid**



[0135] Step a: A solution of (*S*)-4-((4-bromo-2,3-dihydro-1*H*-inden-1-yl)oxy)-5-chloro-2-hydroxybenzaldehyde (600.0 mg, 1.63 mmol), *bis*(pinacolato)diboron (621.0 mg, 2.45 mmol),

and potassium acetate (480.0 mg, 4.89 mmol) in dioxane (15 mL) was degassed with nitrogen for 15 min before the addition of 1,1'-bis(diphenylphosphino)ferrocene]dichloropalladium(II) complex with dichloromethane. The mixture was degassed further for 5 min and the reaction mixture was heated to 80 °C. After 11 h, the solution was cooled to room temperature and water was added (10 mL). The reaction mixture was extracted with EtOAc (10 mL x 3). The combined organics was dried over MgSO<sub>4</sub>, filtered, and concentrated *in vacuo*. The crude product was purified by flash chromatography (SiO<sub>2</sub>, 100% hexane to 10% EtOAc in hexane) to obtain white solid (*S*)-5-chloro-2-hydroxy-4-((4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-2,3-dihydro-1*H*-inden-1-yl)oxy)benzaldehyde

[0136] Step b: A solution of (*S*)-5-chloro-2-hydroxy-4-((4-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-2,3-dihydro-1*H*-inden-1-yl)oxy)benzaldehyde (664.0 mg, 1.60 mmol), 1-bromo-3-(3-bromopropoxy)-2-chlorobenzene (525.0 mg, 1.60 mmol), and aqueous 0.5 M tripotassium phosphate (9.6 mL, 4.8 mmol) in THF (20 mL) was degassed with nitrogen for 25 min before G2 XPhos Pd (0.74 g, 0.94 mmol) was added. After degassing for an additional 10 min, the solution was allowed to stir at room temperature for 20 h. Water (20 mL) was added to the reaction mixture, and the reaction mixture was extracted with EtOAc (20 mL x 3). The combined organics was dried over MgSO<sub>4</sub>, filtered, and concentrated *in vacuo*. The crude product was purified by flash chromatography (SiO<sub>2</sub>, 100% Hexane to 15% EtOAc in Hexane) to obtain (*S*)-4-((4-(3-(3-bromopropoxy)-2-chlorophenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-5-chloro-2-hydroxybenzaldehyde.

[0137] Step c: A solution of (*S*)-4-((4-(3-(3-bromopropoxy)-2-chlorophenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-5-chloro-2-hydroxybenzaldehyde (520.0 mg, 0.97 mmol) and pyridine (1.0 mL, 19.4 mmol) in dry DCM (15 mL) was cooled to -20 °C and added trifluoromethanesulfonic anhydride (0.25 mL, 1.46 mmol) dropwise. The reaction mixture was slowly warmed up to room temperature and allowed to stir for 2 h. Et<sub>2</sub>O (20 mL) was added to the reaction mixture, and the reaction mixture was washed with 1 N HCl (10 mL), then saturated NaHCO<sub>3</sub> solution and then brine. The combined organics was dried over MgSO<sub>4</sub>, filtered, and concentrated *in vacuo*. The crude product was purified by flash chromatography (SiO<sub>2</sub>, 100% Hexane to 20% EtOAc in Hexane) to obtain white solid (*S*)-5-((4-(3-(3-bromopropoxy)-2-chlorophenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-4-chloro-2-formylphenyl trifluoromethanesulfonate.



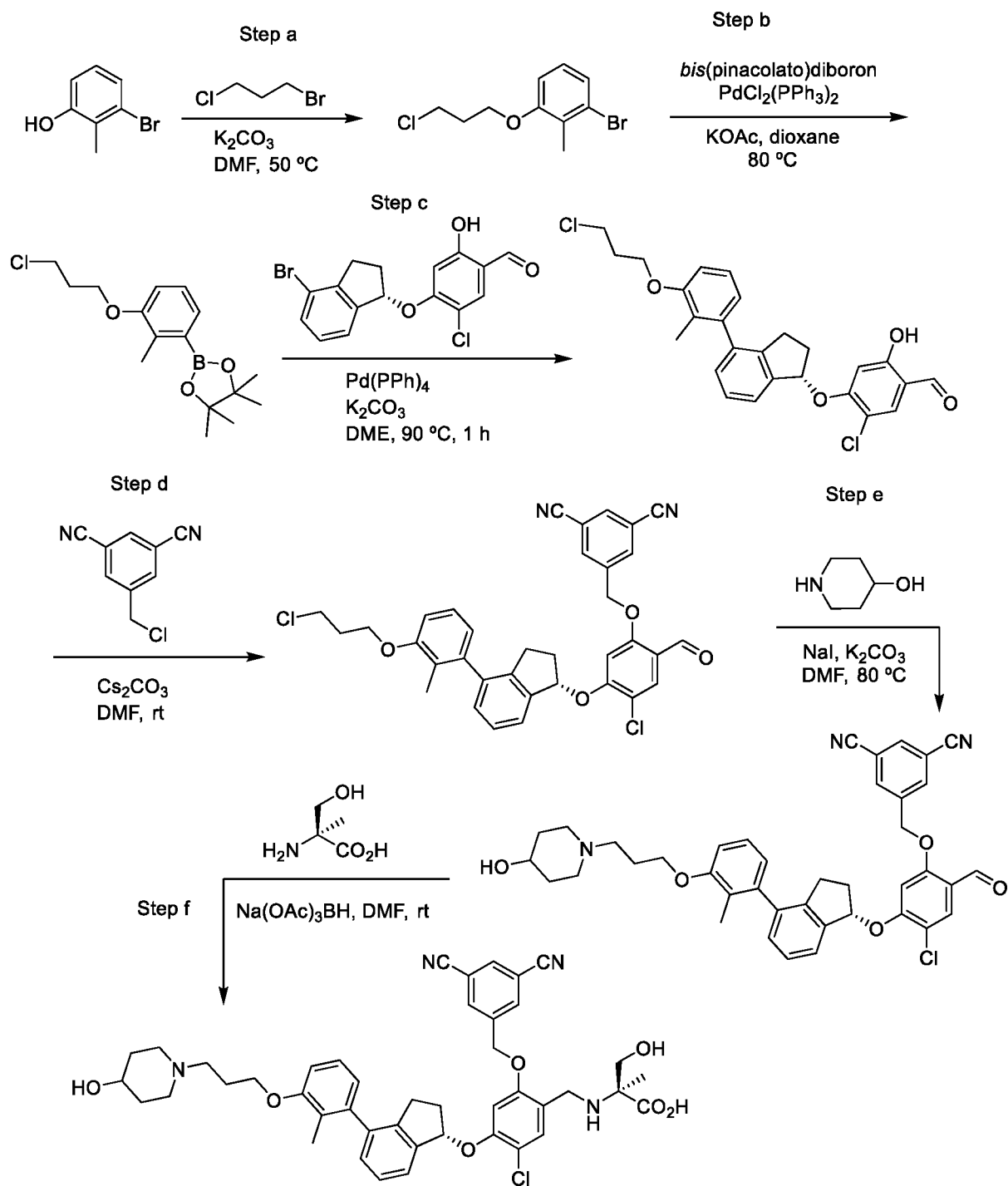
[0138] Step d: A solution of (*S*)-5-((4-(3-(3-bromopropoxy)-2-chlorophenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-4-chloro-2-formylphenyl trifluoromethanesulfonate (100.0 mg, 0.15 mmol) and (5-cyanopyridin-3-yl)boronic acid (27.0 mg, 0.18 mmol) and 2 M potassium carbonate (0.23 mL, 0.45 mmol) in DME (3 mL) was degassed with nitrogen for 15 min before the addition of  
5 *tetra*(triphenylphosphino)palladium (120.0 mg, 0.10 mmol). The mixture was degassed further for 5 min and the reaction mixture was allowed to warm to 70 °C and stirred for 12 h. The reaction mixture was cooled to room temperature and water was added (10 mL). The reaction mixture was extracted with DCM (10 mL x 3). The combined organics was dried over MgSO<sub>4</sub>, filtered, and concentrated *in vacuo*. The crude product was purified by flash chromatography  
10 (SiO<sub>2</sub>, 100% hexane to 50% EtOAc in hexane) to obtain a white solid (*S*)-5-(5-((4-(3-(3-bromopropoxy)-2-chlorophenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-4-chloro-2-formylphenyl)nicotinonitrile.

[0139] Step e: A slurry of (*S*)-5-(5-((4-(3-(3-bromopropoxy)-2-chlorophenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-4-chloro-2-formylphenyl)nicotinonitrile (54.0 mg, 0.087 mmol), azetidin-3-ol  
15 (9.5 mg, 0.13 mmol), potassium carbonate (30.0 mg, 0.22 mmol) and sodium iodide (13.0 mg, 0.087 mmol) in DMF (2 mL) was warmed up to 80 °C and stirred for 12 h. The reaction mixture was cooled to room temperature and water was added (2 mL). The reaction mixture was extracted with EtOAc (5 mL x 3). The combined organics was dried over Na<sub>2</sub>SO<sub>4</sub>, filtered, and concentrated *in vacuo*. The crude product was purified by flash chromatography (SiO<sub>2</sub>, 100%  
20 dichloromethane to 20% methanol in dichloromethane) to obtain white solid (*S*)-5-(4-chloro-5-((4-(2-chloro-3-(3-(3-hydroxyazetidin-1-yl)propoxy)phenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-formylphenyl)nicotinonitrile.

[0140] Step f: A mixture of (*S*)-5-(4-chloro-5-((4-(2-chloro-3-(3-(3-hydroxyazetidin-1-yl)propoxy)phenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-formylphenyl)nicotinonitrile (10.0 mg,  
25 0.016 mmol) and α-Me-*L*-serine (10.1 mg, 0.081 mmol) was stirred in DMF (2 mL) for 1 h before sodium triacetoxyborohydride (13.0 mg, 0.064 mmol) was added. The reaction mixture was left to stir overnight at room temperature. The majority of DMF was removed *in vacuo* and the crude material was purified by reverse phase preparative HPLC (CH<sub>3</sub>CN–H<sub>2</sub>O with 0.1% TFA) to obtain (*S*)-2-((5-chloro-4-(((*S*)-4-(2-chloro-3-(3-(3-hydroxyazetidin-1-yl)propoxy)phenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-(5-cyanopyridin-3-yl)benzyl)amino)-3-  
30

hydroxy-2-methylpropanoic acid as TFA salt form and later converted to trifluoro ammonium salt. MS: 717.2 [M+H]; <sup>1</sup>H NMR (400 MHz, Methanol-*d*<sub>4</sub>)  $\delta$  8.98 (d, *J* = 2.0 Hz, 1H), 7.90 (s, 1H), 7.44 (s, 1H), 7.34 (q, *J* = 7.5 Hz, 4H), 7.15 (dd, *J* = 23.3, 7.8 Hz, 2H), 6.02 (d, *J* = 20.0 Hz, 1H), 4.56 (d, *J* = 9.6 Hz, 2H), 4.38 – 4.01 (m, 6H), 3.99 – 3.78 (m, 1H), 3.68 (d, *J* = 12.2 Hz, 1H), 3.57 – 3.38 (m, 2H), 3.20 – 2.48 (m, 2H), 2.16 (s, 4H), 1.49 (s, 3H).

**Example 6: Synthesis of (*S*)-2-((5-chloro-2-((3,5-dicyanobenzyl)oxy)-4-(((*S*)-4-(3-(3-(4-hydroxypiperidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)benzyl)amino)-3-hydroxy-2-methylpropanoic acid**



[0141] Step a: To a solution of 3-bromo-2-methylphenol (10.0 g, 53.5 mmol) in DMF (50 mL) was added 1-bromo-3-chloropropane (8.42 g, 53.5 mmol) and potassium carbonate (8.87 g, 64.2 mmol). The reaction mixture was heated up to 50 °C and stirred at 50 °C for 16 h. Then it

was cooled down to room temperature. Water (50 mL) and DCM (100 mL) were added to the reaction mixture and after stirring for a few minutes, the biphasic solution was poured into a separatory funnel. The aqueous layer was extracted with DCM (2 x 50 mL). The combined organics was dried over MgSO<sub>4</sub>, filtered, and concentrated *in vacuo*. The crude product was purified by flash chromatography (SiO<sub>2</sub>, 100% hexane to 20% EtOAc in hexane) to obtain 1-bromo-3-(3-chloropropoxy)-2-methylbenzene.

[0142] Step b: To a slurry of 1-bromo-3-(3-chloropropoxy)-2-methylbenzene (2.40 g, 9.10 mmol), *bis*(pinacolato)diboron (3.00 g, 11.83 mmol), and potassium acetate (2.68 g, 27.30 mmol) in dioxane (40 mL) was degassed with nitrogen for 15 min before the addition of *bis*(triphenylphosphino)dichloropalladium. The mixture was degassed further for 5 min and the reaction mixture was heated to 80 °C. After 11 h, the solution was cooled to room temperature and water was added (20 mL). The reaction mixture was extracted with EtOAc (30 mL x 3). The combined organics was dried over MgSO<sub>4</sub>, filtered, and concentrated *in vacuo*. The crude product was purified by flash chromatography (SiO<sub>2</sub>, 100% hexane to 10% EtOAc in hexane) to obtain a colorless oil 2-(3-(3-chloropropoxy)-2-methylphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane.

[0143] Step c: To a slurry of (*S*)-4-((4-bromo-2,3-dihydro-1*H*-inden-1-yl)oxy)-5-chloro-2-hydroxybenzaldehyde (370.0 mg, 1.0 mmol), 2-(3-(3-chloropropoxy)-2-methylphenyl)-4,4,5,5-tetramethyl-1,3,2-dioxaborolane (370.0 mg, 1.20 mmol), and 2 M potassium carbonate (1.50 mL, 3.0 mmol) in DME (10 mL) was degassed with nitrogen for 15 min before the addition of *tetra*(triphenylphosphino)palladium (120.0 mg, 0.10 mmol). The mixture was degassed further for 5 min and the reaction mixture was heated to 90 °C. After 1 h, the solution was cooled to room temperature and water was added (10 mL). The reaction mixture was extracted with EtOAc (10 mL x 3). The combined organics was dried over MgSO<sub>4</sub>, filtered, and concentrated *in vacuo*. The crude product was purified by flash chromatography (SiO<sub>2</sub>, 100% hexane to 5% EtOAc in hexane) to obtain a brown oil To a slurry of (*S*)-5-chloro-4-((4-(3-(3-chloropropoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-hydroxybenzaldehyde.

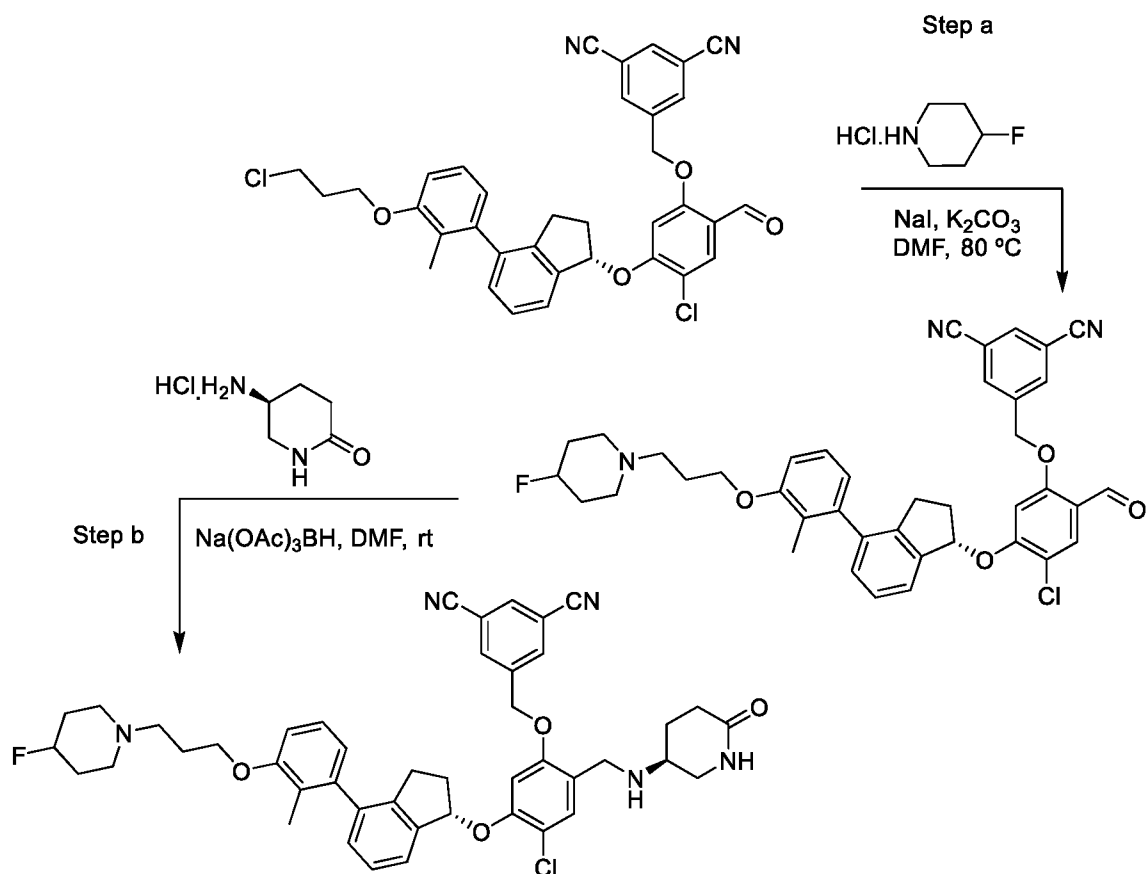
[0144] Step d: To a slurry of (*S*)-4-((4-bromo-2,3-dihydro-1*H*-inden-1-yl)oxy)-5-chloro-2-hydroxybenzaldehyde(*S*)-5-chloro-4-((4-(3-(3-chloropropoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-hydroxybenzaldehyde (410.0 mg, 0.88 mmol) and cesium carbonate (860.0 mg, 2.64 mmol) in DMF (3 mL) was added 5-(chloromethyl)isophthalonitrile (310.0 mg, 1.75 mmol). The mixture was stirred at room temperature for 1 h and water was added (3 mL). The reaction mixture was extracted with EtOAc (10 mL x 3). The combined organics was dried over MgSO<sub>4</sub>, filtered, and concentrated *in vacuo*. The crude product was purified by flash chromatography (SiO<sub>2</sub>, 100% hexane to 30% EtOAc in hexane) to obtain white solid (*S*)-5-((4-chloro-5-((4-(3-(3-chloropropoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-formylphenoxy)methyl)isophthalonitrile.

[0145] Step e: A slurry of (*S*)-5-((4-chloro-5-((4-(3-(3-chloropropoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-formylphenoxy)methyl)isophthalonitrile (259.0 mg, 0.42 mmol), piperidin-4-ol (51.4 mg, 0.50 mmol), potassium carbonate (70.0 mg, 0.50 mmol) and sodium iodide (63.0 mg, 0.42 mmol) in DMF (2 mL) was warmed up to 80 °C and stirred for 12 h. The reaction mixture was cooled to room temperature and water was added (2 mL). The reaction mixture was extracted with EtOAc (5 mL x 3). The combined organics was dried over Na<sub>2</sub>SO<sub>4</sub>, filtered, and concentrated *in vacuo*. The crude product was purified by flash chromatography (SiO<sub>2</sub>, 100% dichloromethane to 20% methanol in dichloromethane) to obtain white solid (*S*)-5-((4-chloro-2-formyl-5-((4-(3-(3-(4-hydroxypiperidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)phenoxy)methyl)isophthalonitrile.

[0146] Step f: A mixture of (*S*)-5-((4-chloro-2-formyl-5-((4-(3-(3-(4-hydroxypiperidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)phenoxy)methyl)isophthalonitrile (100 mg, 0.15 mmol) and  $\alpha$ -Me-*L*-serine (119.1 mg, 0.74 mmol) was stirred in DMF (2 mL) for 1 h before sodium triacetoxyborohydride (127.0 mg, 0.6 mmol) was added in small portions over 1 h. The reaction mixture was left to stir overnight at room temperature. The majority of DMF was removed *in vacuo* and the crude material was purified by reverse phase preparative HPLC (CH<sub>3</sub>CN–H<sub>2</sub>O with 0.1% TFA) to obtain (*S*)-2-((5-chloro-2-((3,5-dicyanobenzyl)oxy)-4-(((*S*)-4-(3-(3-(4-hydroxypiperidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)benzyl)amino)-3-hydroxy-2-methylpropanoic acid as TFA salt form and later converted to trifluoro ammonium salt. MS: 779.3 [M+H]<sup>+</sup>; <sup>1</sup>H NMR (400 MHz, Methanol-*d*<sub>4</sub>) <sup>1</sup>H NMR

(400 MHz, Methanol- $d_4$ )  $\delta$  8.26 (d,  $J$  = 4.6 Hz, 2H), 8.17 (t,  $J$  = 1.5 Hz, 1H), 7.55 (s, 1H), 7.26 (s, 2H), 7.20 (s, 1H), 7.14 – 7.07 (m, 1H), 6.96 (t,  $J$  = 9.9 Hz, 2H), 6.78 (dd,  $J$  = 20.6, 7.6 Hz, 1H), 5.98 (s, 1H), 5.37 (d,  $J$  = 16.3 Hz, 2H), 4.33 – 4.23 (m, 2H), 4.15 (s, 3H), 3.96 (d,  $J$  = 12.0 Hz, 1H), 3.76 (d,  $J$  = 12.0 Hz, 1H), 3.37 (s, 1H), 3.23 (s, 5H), 2.59 (s, 1H), 2.46 (s, 1H), 2.29 (s, 2H), 2.13 (s, 2H), 1.98 (d,  $J$  = 6.8 Hz, 4H), 1.48 (s, 3H).

**Example 7: Synthesis of 5-((4-chloro-5-(((*S*)-4-(3-(3-(4-fluoropiperidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-formylphenoxy)methyl)isophthalonitrile**



10 [0147] Step a: A slurry of (*S*)-5-((4-chloro-5-((4-(3-(3-chloropropoxy)-2-methylphenyl)-2,3-dihydro-1*H*-inden-1-yl)oxy)-2-formylphenoxy)methyl)isophthalonitrile (728.0 mg, 1.19 mmol), 4-fluoropiperidine hydrochloride (200.0 mg, 1.43 mmol), potassium carbonate (411.0 mg, 2.98 mmol) and sodium iodide (179.0 mg, 1.19 mmol) in DMF (5 mL) was warmed up 80 °C and

stirred for 12 h. The reaction mixture was cooled to room temperature and water was added (2 mL). The reaction mixture was extracted with EtOAc (5 mL x 3). The combined organics were dried over Na<sub>2</sub>SO<sub>4</sub>, filtered, and concentrated *in vacuo*. The crude product was purified by flash chromatography (SiO<sub>2</sub>, 100% dichloromethane to 20% methanol in dichloromethane) to obtain yellow oil (S)-5-((4-chloro-5-((4-(3-(3-(4-fluoropiperidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1H-inden-1-yl)oxy)-2-formylphenoxy)methyl)isophthalonitrile.

**[0148]** Step b: A mixture of (S)-5-((4-chloro-5-((4-(3-(3-(4-fluoropiperidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1H-inden-1-yl)oxy)-2-formylphenoxy)methyl)isophthalonitrile (50.0 mg, 0.074 mmol) and (S)-5-aminopiperidin-2-one hydrochloride (33.0 mg, 0.22 mmol) was stirred in DMF (2 mL) for 1 h before sodium triacetoxyborohydride (47.0 mg, 0.22 mmol) was added. The reaction mixture was left to stir overnight at room temperature. The majority of DMF was removed *in vacuo* and the crude material was purified by reverse phase preparative HPLC (CH<sub>3</sub>CN–H<sub>2</sub>O with 0.1% TFA) to obtain 5-((4-chloro-5-(((S)-4-(3-(3-(4-fluoropiperidin-1-yl)propoxy)-2-methylphenyl)-2,3-dihydro-1H-inden-1-yl)oxy)-2-(((S)-6-oxopiperidin-3-yl)amino)methyl)phenoxy)methyl)isophthalonitrile as TFA salt form which was then passed through basic cartridge to convert it to freeform. MS: 776.2 [M+H]; <sup>1</sup>H NMR (400 MHz, Methanol-*d*<sub>4</sub>)  $\delta$  8.23 – 8.15 (m, 2 H), 8.02 – 7.95 (m, 1H), 7.47 – 7.38 (m, 2H), 7.30 – 7.14 (m, 2H), 7.11 (s, 1H), 6.96 (dd, *J* = 17.7, 8.6 Hz, 2H), 6.75 (dd, *J* = 19.1, 7.6 Hz, 1H), 5.92 (s, 1H), 5.36 – 5.27 (m, 2H), 4.75 (d, *J* = 12.2 Hz, 1H), 4.13 (t, *J* = 5.9 Hz, 2H), 3.97 (d, *J* = 13.2 Hz, 1H), 3.92 – 3.82 (m, 1H), 3.52 (dd, *J* = 17.5, 8.9 Hz, 1H), 3.30 (dt, *J* = 3.3, 1.7 Hz, 6H), 3.05 (s, 6H), 2.83 (m, 1H), 2.43 (dt, *J* = 11.5, 6.5 Hz, 1H), 2.32 (dd, *J* = 15.5, 8.6 Hz, 1H), 2.19 (m, 2H), 2.12 (m, 1H), 2.06 (m, 4H), 1.97 (d, *J* = 16.2 Hz, 3H).

**[0149]** Compounds in Table 1 were prepared by methods as described in the Examples, and evaluated according to the assay below. The IC<sub>50</sub> of the compounds are presented in Table 1 as follows:

+, 20000 nM  $\geq$  IC<sub>50</sub>  $\geq$  500 nM;

++, 500 nM > IC<sub>50</sub>  $\geq$  5 nM;

+++, 5 nM > IC<sub>50</sub>.

**Characterization Conditions**

[0150] Reverse phase HPLC conditions used for determination of retention times in Table 1:

Column: ZORBAX (SB-C18 2.1 x 50 mm, 5  $\mu$ m)

Mobile phase A: 95% H<sub>2</sub>O, 5% MeCN (with 0.1% Formic Acid)

Mobile phase B: 5% H<sub>2</sub>O, 95% MeCN (with 0.1% Formic Acid)

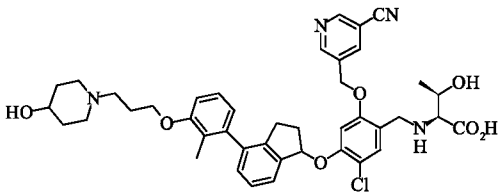
Flow rate: 1.0 mL/min

Gradient: 20 to 100% B in 3.5 min (for R<sub>t</sub> without \*) or 20 to 100% B in 5.5 min (for R<sub>t</sub> with \*).

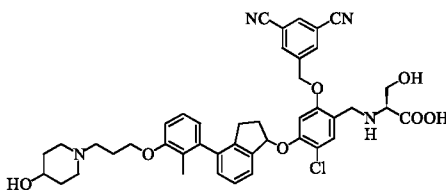
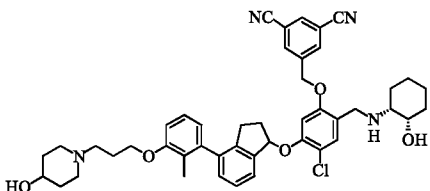
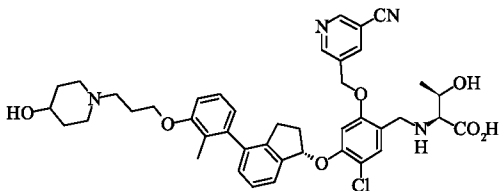
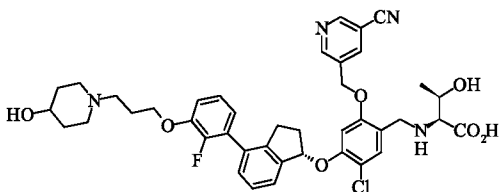
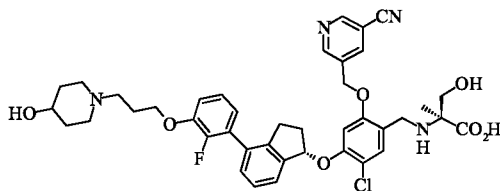
**Biological Example: Enzyme-Linked Immunosorbent Assay - ELISA**

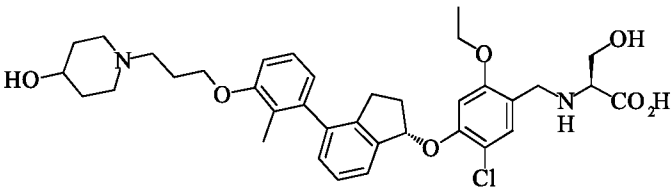
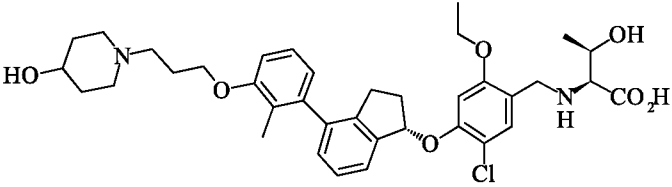
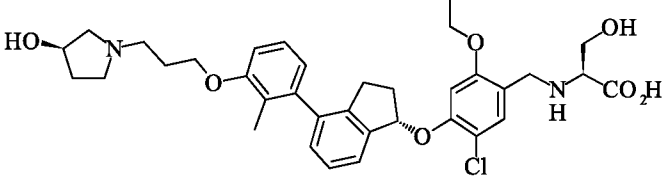
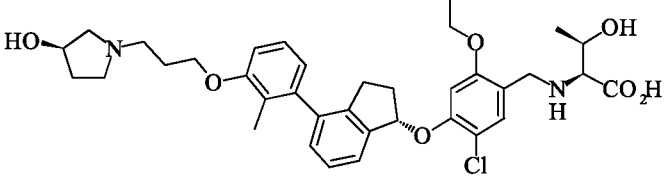
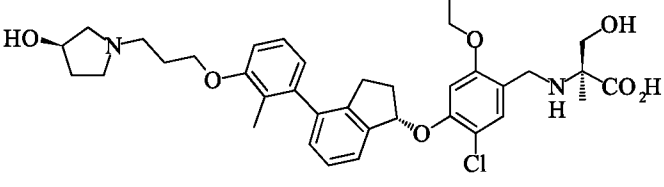
[0151] 96 Well plates were coated with 1  $\mu$ g/mL of human PD-L1 (obtained from R&D) in PBS overnight at 4 °C. The wells were then blocked with 2% BSA in PBS (W/V) with 0.05 % TWEEN-20 for 1 hour at 37 °C. The plates were washed 3 times with PBS/0.05% TWEEN-20 and the compounds were serial diluted (1:5) in dilution medium and added to the ELISA plates. Human PD-1 and biotin 0.3  $\mu$ g/mL (ACRO Biosystems) were added and incubated for 1 hour at 37 °C then washed 3 times with PBS/0.05% TWEEN-20. A second block was performed with 2% BSA in PBS (W/V)/0.05% TWEEN-20 for 10 min at 37 °C and was washed 3 times with PBS/0.05% TWEEN-20. Streptavidin –HRP was added for 1 hour at 37 °C then washed 3 times with PBS/0.05% TWEEN-20. TMB substrate was added and reacted for 20 min at 37 °C. A stop solution (2 N aqueous H<sub>2</sub>SO<sub>4</sub>) was added. The absorbance was read at 450 nm using a micro-plate spectrophotometer. The results are shown in Table 1.

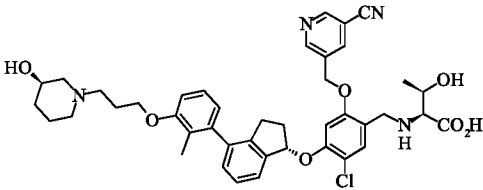
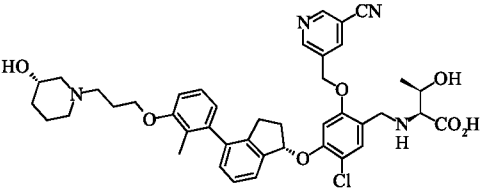
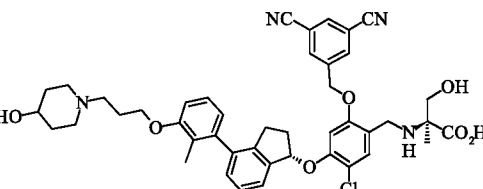
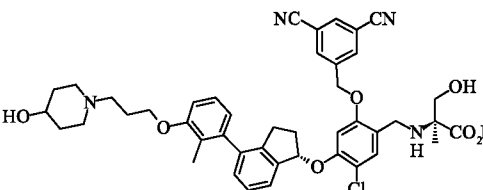
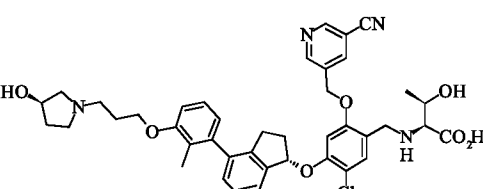
**Table 1**

Compound Structure	ELISA IC <sub>50</sub> (nM)	MS: (ES) <i>m/z</i> (M+H)	RP HPLC R <sub>t</sub> (min)
	+++	755.30	1.76

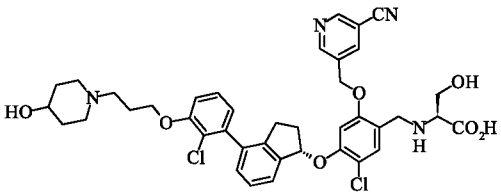
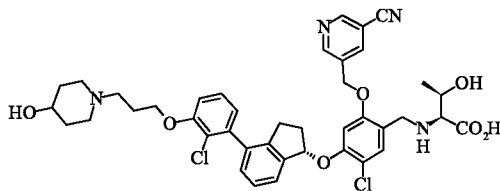
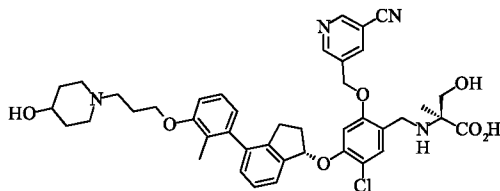
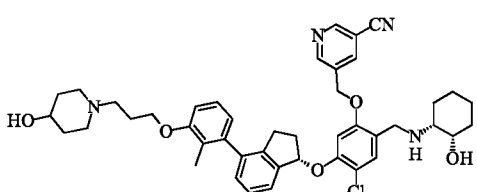
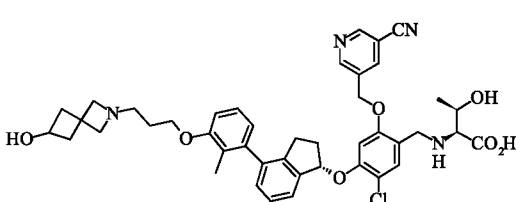


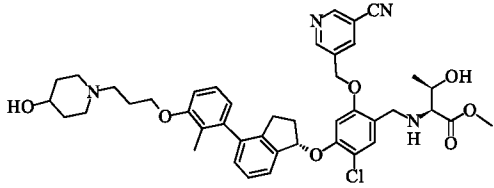
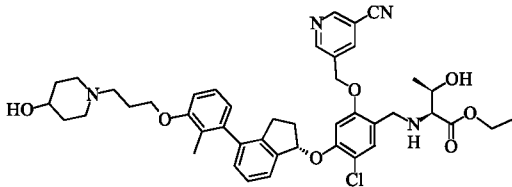
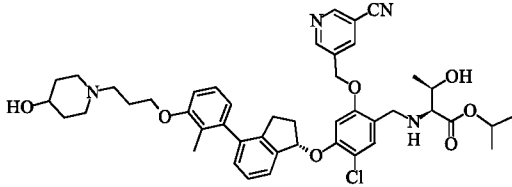
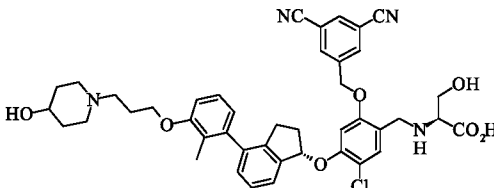
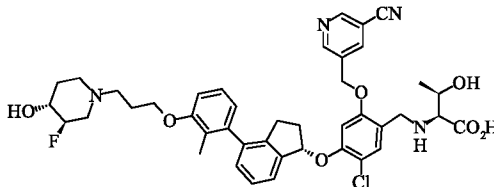
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	+++	759.20	1.57

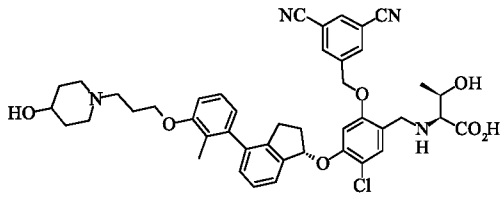
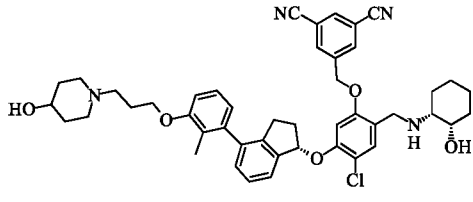
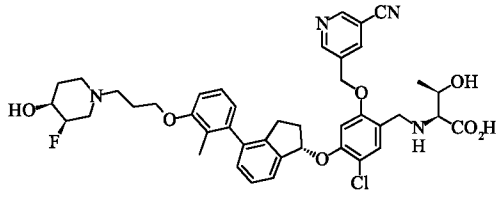
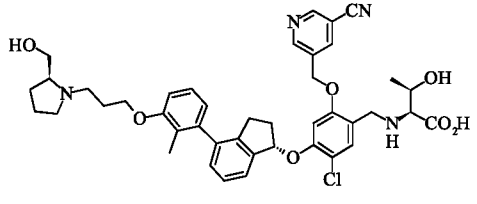
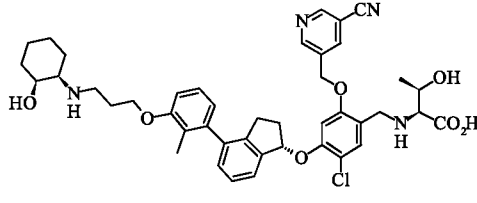
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	+++	653.30	1.91
	+++	653.30	1.52

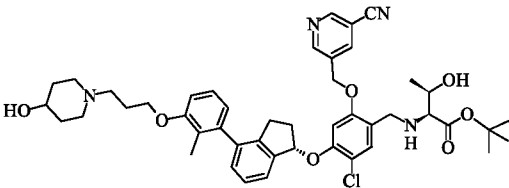
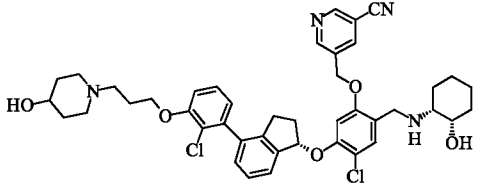
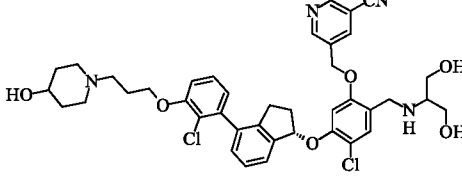
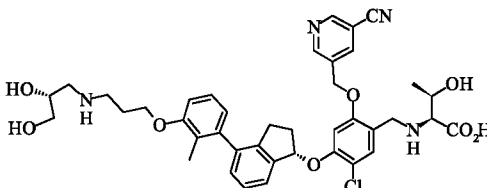
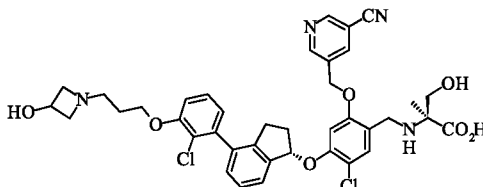
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	+++	741.30	1.77

	+++	757.20	1.90
	++	776.30	1.90
	+++	769.20	2.00
	+++	727.20	2.01
	+++	775.20	1.75

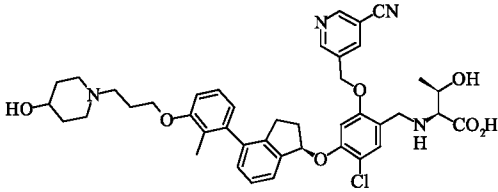
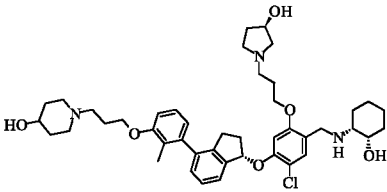
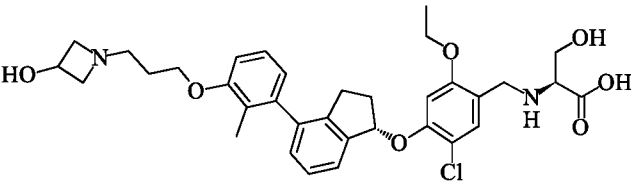
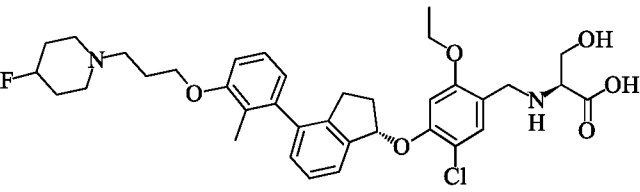
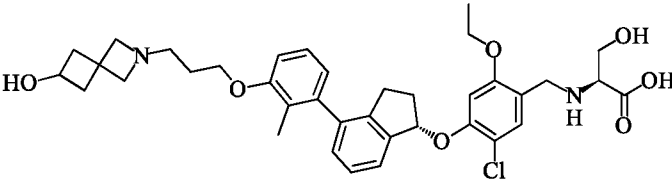
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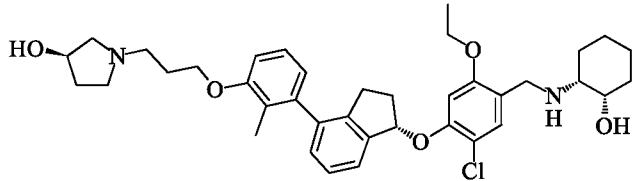
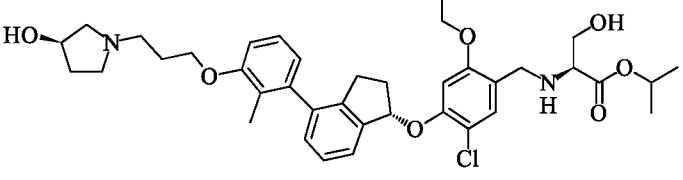
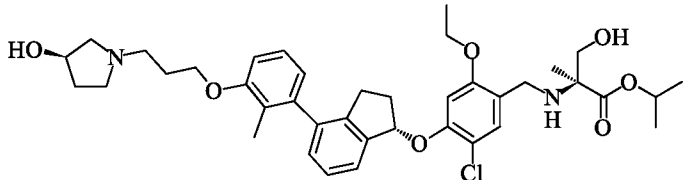
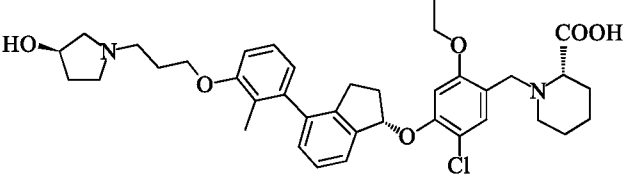
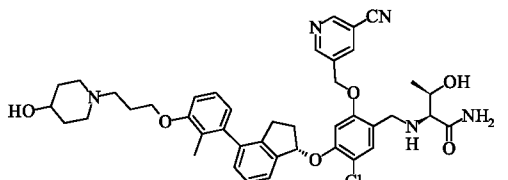
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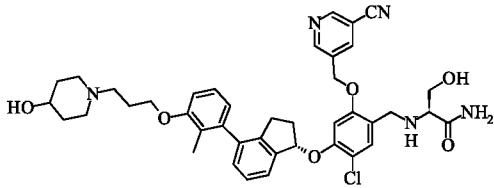
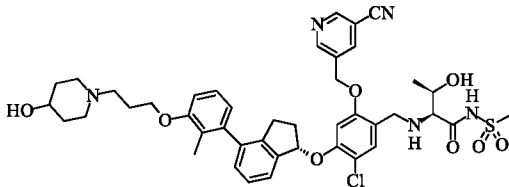
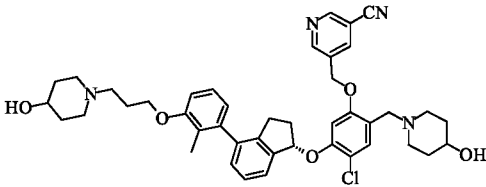
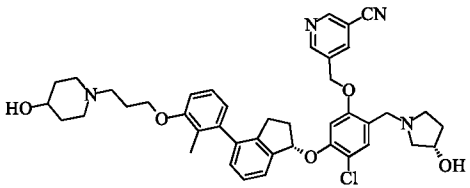
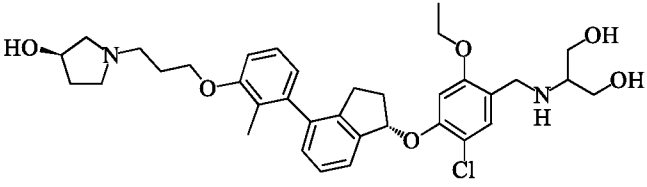
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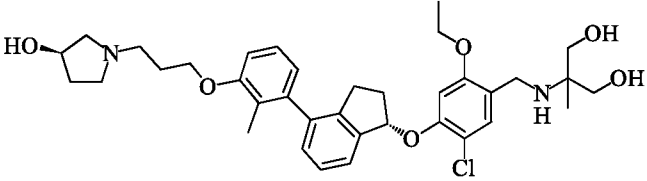
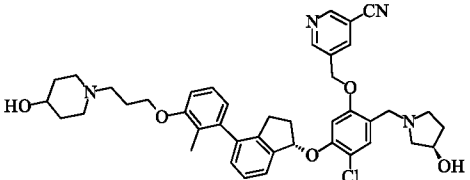
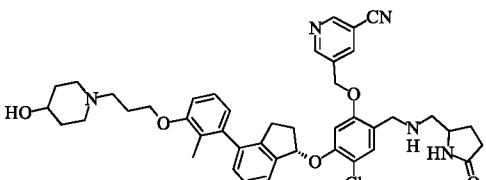
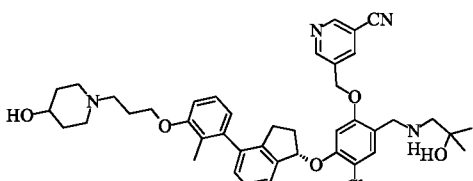
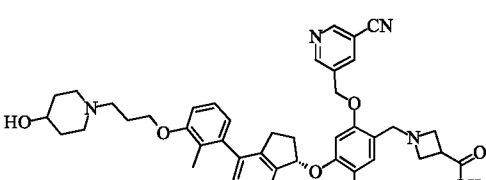
	++	811.30	2.32
	+++	771.20	1.99
	+++	747.20	1.74
	+++	745.30	1.70
	+++	747.20	1.90

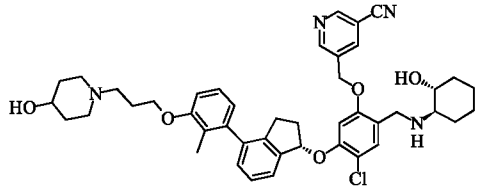
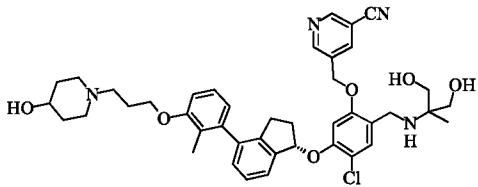
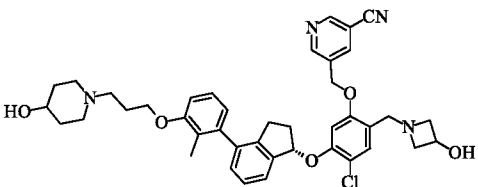
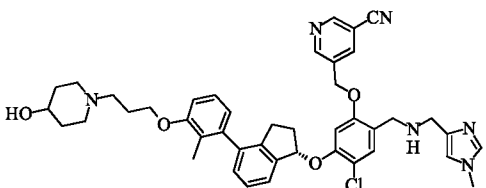
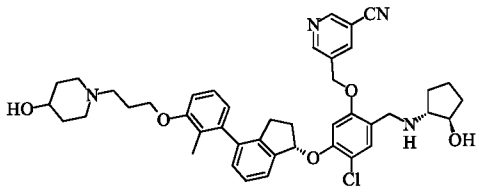


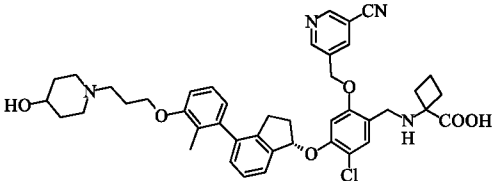
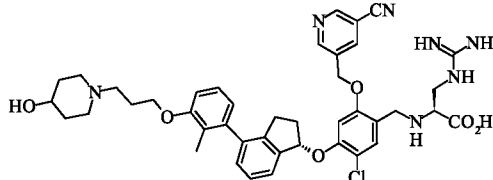
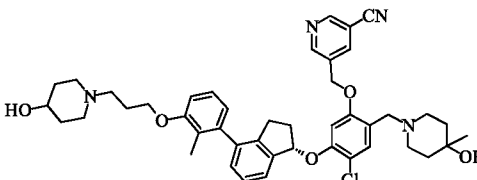
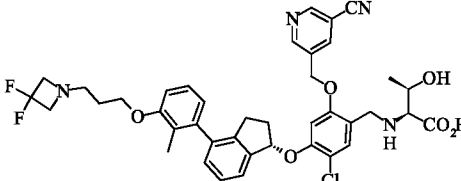
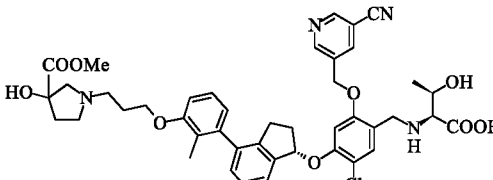
	+++	755.20	1.68
	+++	762.30	1.20
	+++	625.20	1.88
	+++	655.20	1.76
	+++	665.20	1.76

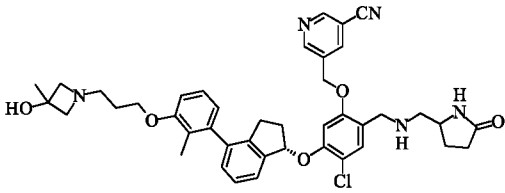
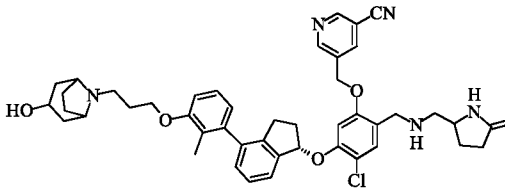
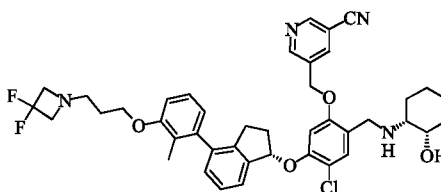
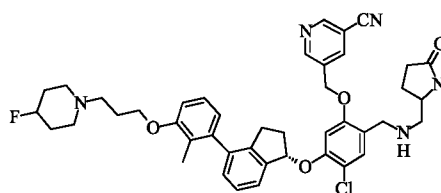
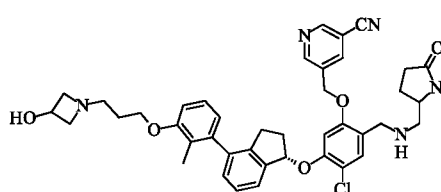
	++	649.20	1.76
	++	681.30	2.31
	++	695.30	2.05
	++	663.30	1.86
	+++	754.20	1.69

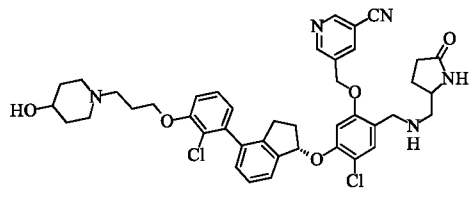
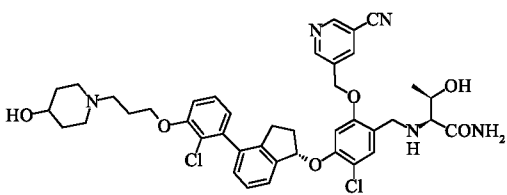
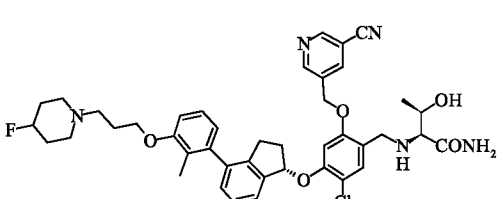
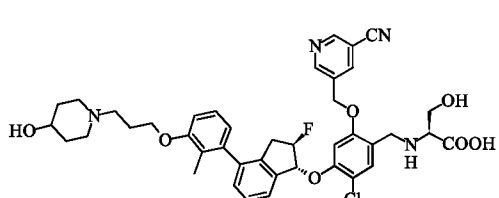
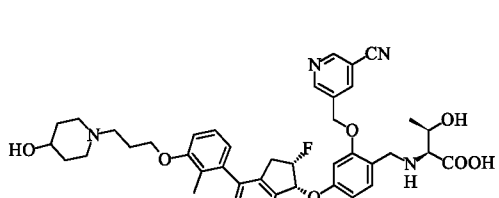
	+++	740.30	1.55
	+++	832.70	2.03
	+++	737.20	1.70
	+++	723.20	1.56
	+++	625.20	1.64

	+++	639.30	1.85
	+++	723.20	1.77
	+++	750.30	1.55
	+++	725.30	1.79
	+++	737.20	2.51

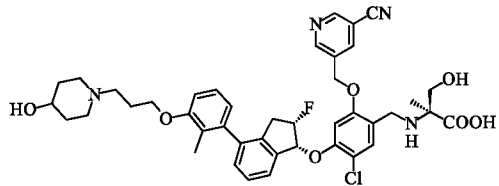
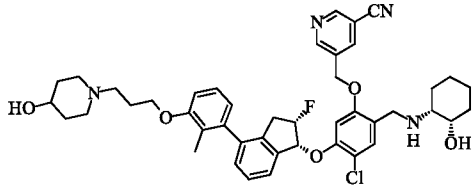
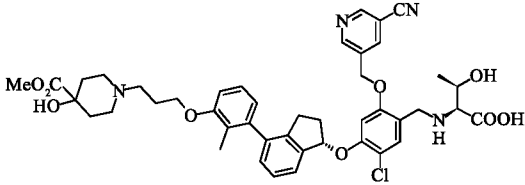
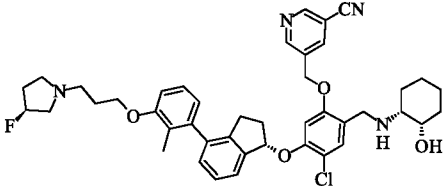
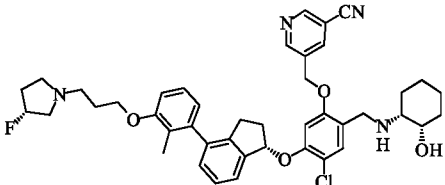
	+++	751.20	1.91
	++	741.30	1.54
	+++	709.20	2.06
	+++	747.20	1.65
	+++	737.20	1.83

	+++	751.20	1.88
	+++	782.30	1.76
	+++	751.20	1.64
	+++	755.20	1.70
	+++	799.70	1.89

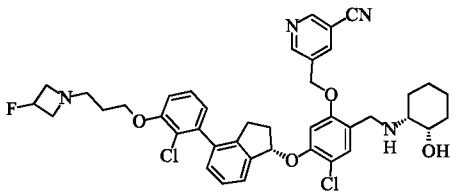
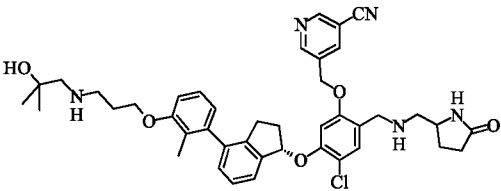
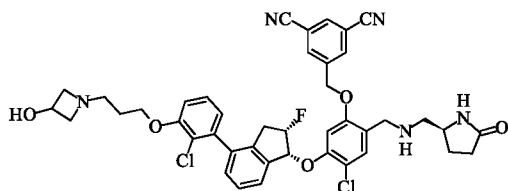
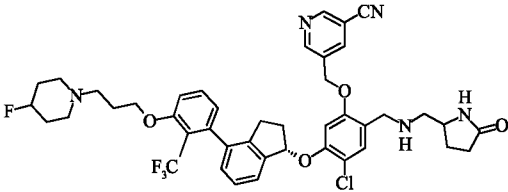
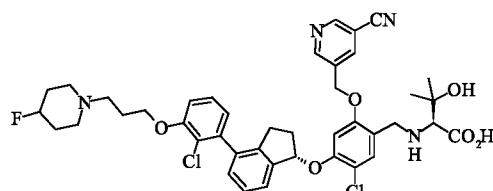
	+++	736.20	1.65
	+++	776.20	1.63
	+++	751.20	2.20
	+++	752.20	1.66
	+++	722.20	1.56

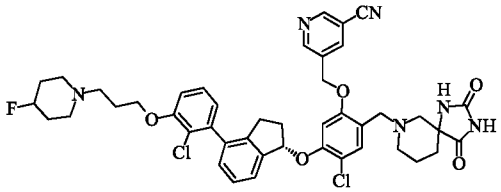
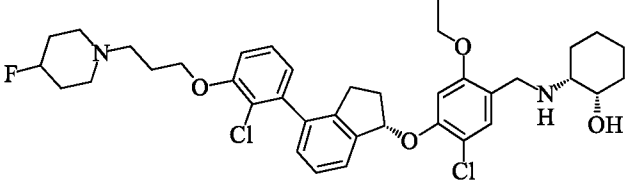
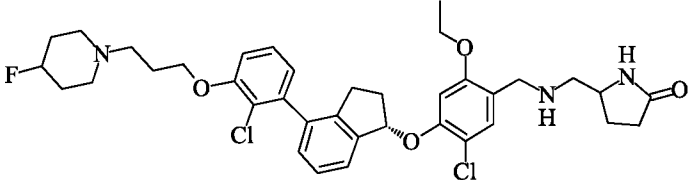
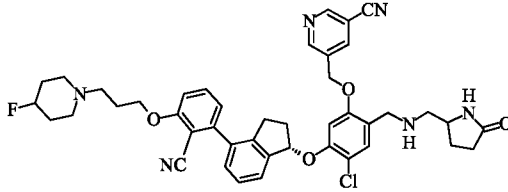
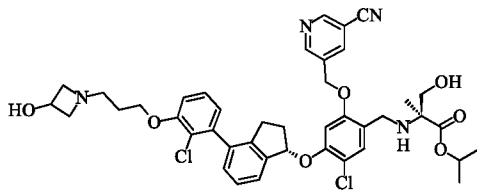
	+++	770.30	1.62
	+++	774.20	1.62
	++	756.20	1.68
	+++	759.20	1.83
	+++	773.20	1.74 <sup>#</sup>

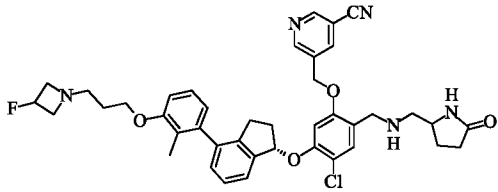
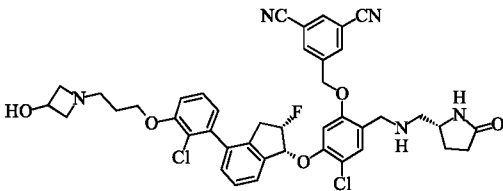
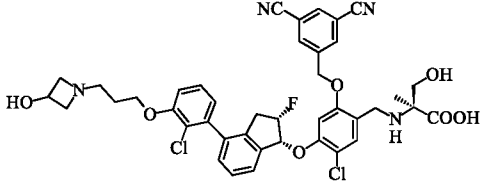
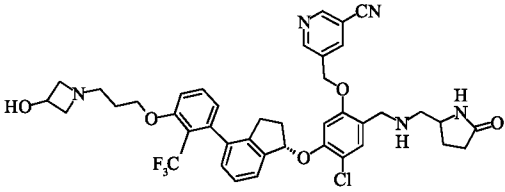
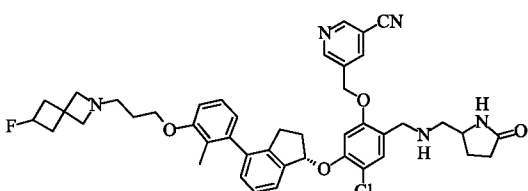


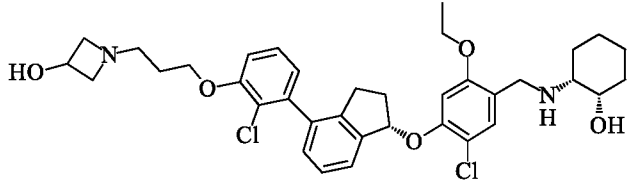
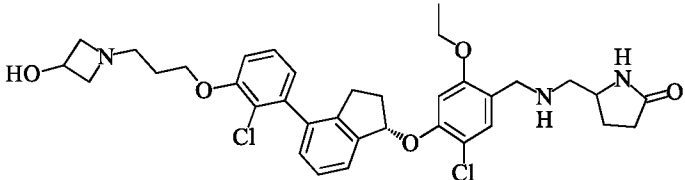
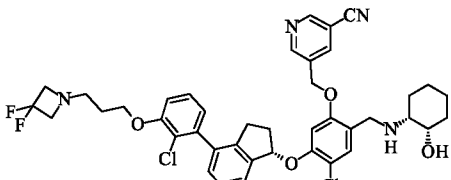
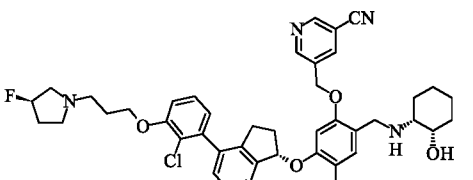
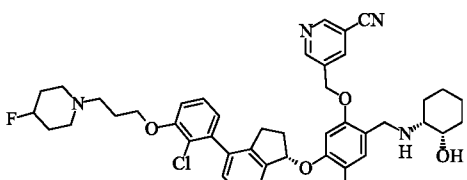
	+++	773.20	1.76 <sup>#</sup>
	+++	769.20	1.61 <sup>#</sup>
	+++	713.20	1.62
	+++	739.20	2.20
	+++	739.20	2.10

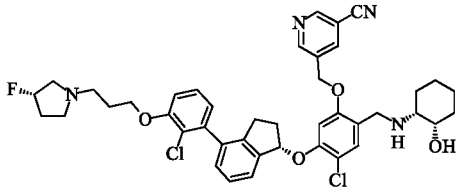
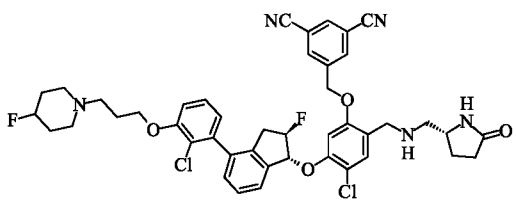
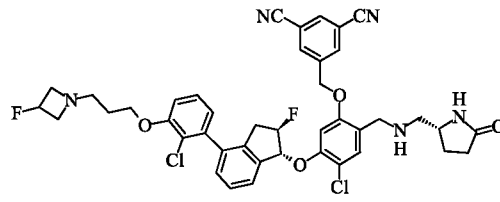
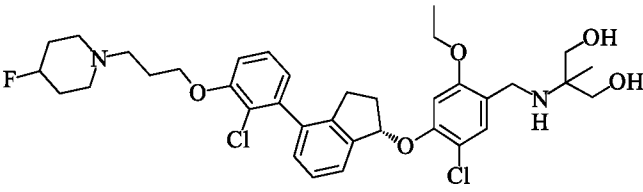
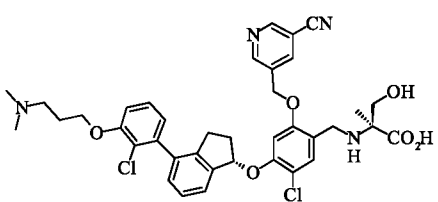
	+++	799.20	1.79
	+++	760.70	2.26
	+++	770.70	2.35*
	+++	785.30	2.20
	+++	803.20	2.70

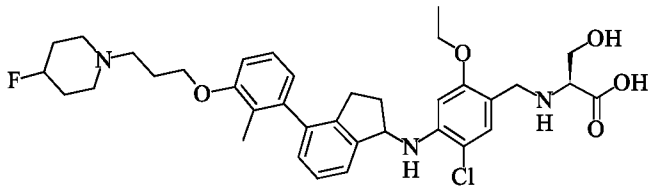
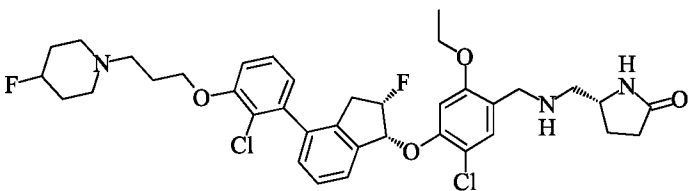
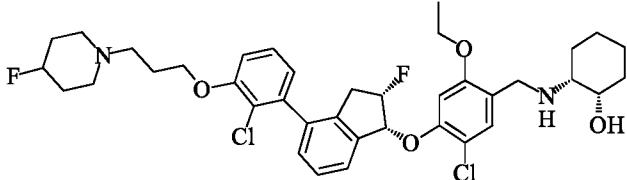
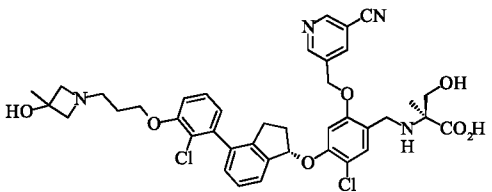
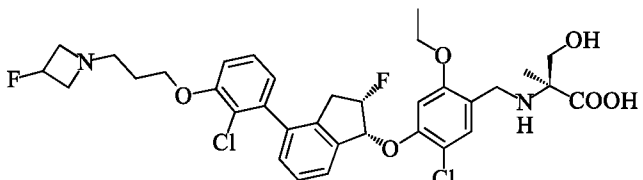
	+++	746.80	2.30
	+++	738.60	1.86
	++	784.70	1.73 <sup>#</sup>
	++	806.70	1.93
	+++	791.50	1.70

	++	827.50	1.80
	++	685.50	1.93
	++	684.50	1.79
	++	763.50	1.51
	+++	789.50	2.02

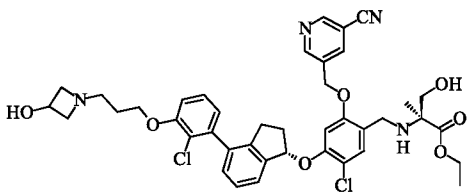
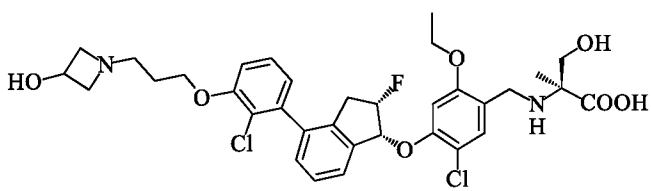
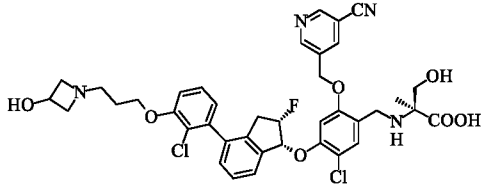
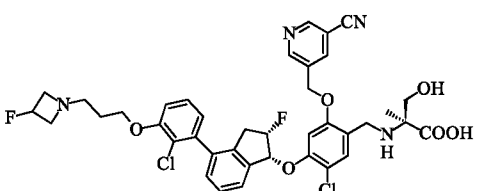
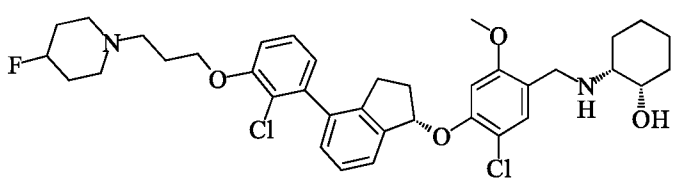
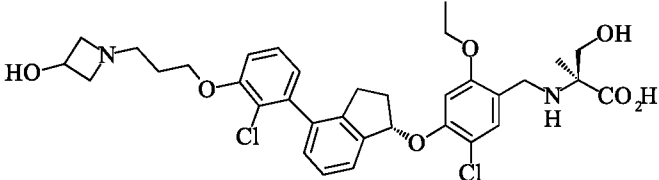
	+++	724.80	3.19
	+++	784.50	1.84 <sup>#</sup>
	+++	789.50	1.78 <sup>#</sup>
	++	776.50	1.67
	++	764.80	3.83

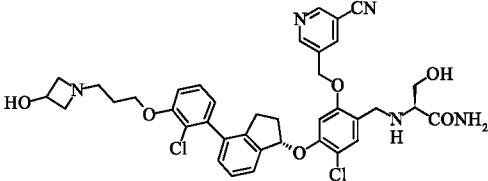
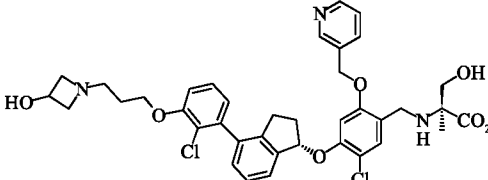
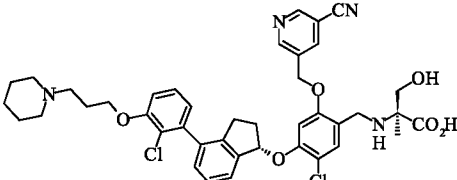
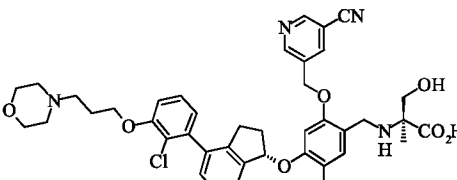
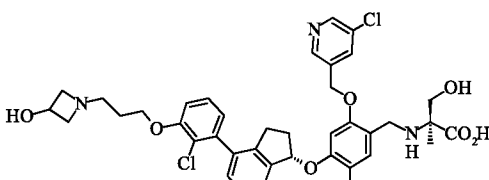
	++	655.20	1.30
	++	654.20	1.14
	++	763.50	2.07
	+++	759.50	1.70
	+++	773.20	3.05*

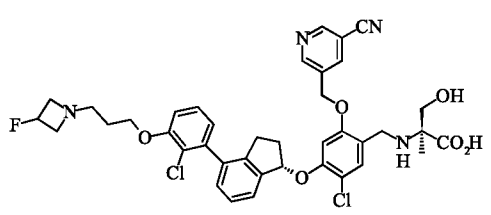
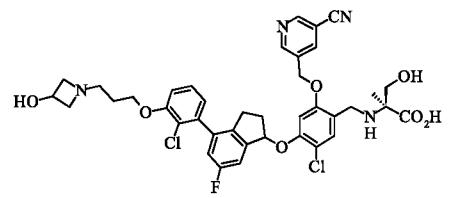
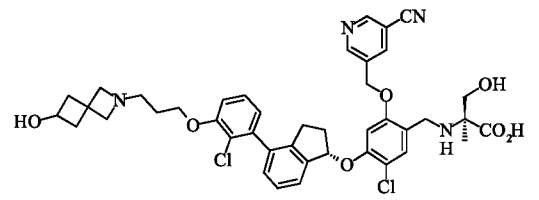
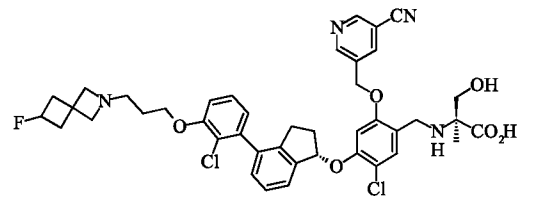
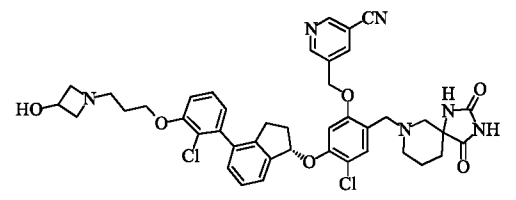
	+++	759.50	1.90
	++	814.50	1.83
	++	786.30	1.69
	++	675.60	1.67
	+++	618.60	2.68

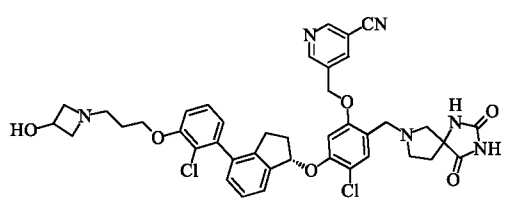
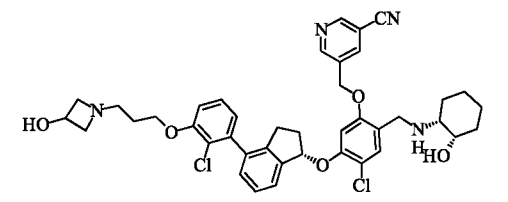
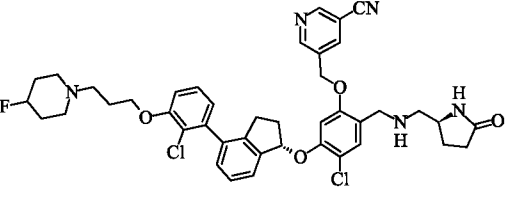
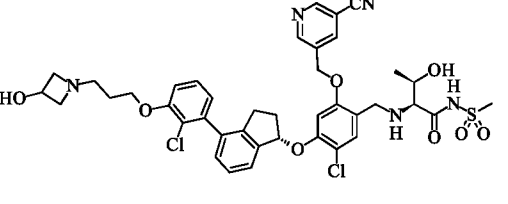
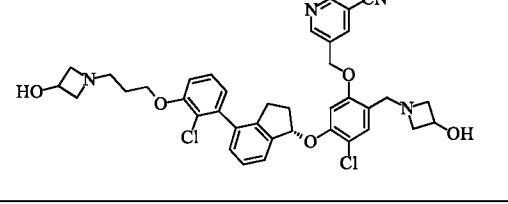
	++	652.20	1.99
	++	702.30	1.64 <sup>#</sup>
	++	703.50	1.67 <sup>#</sup>
	+++	761.70	3.45
	++	679.20	1.66 <sup>#</sup>

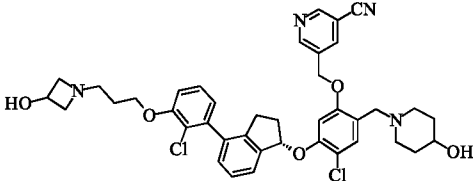
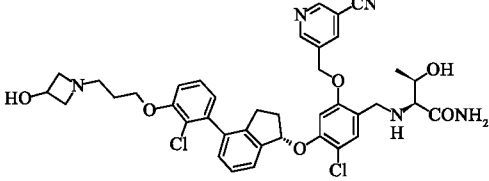
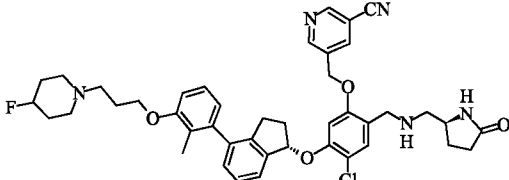
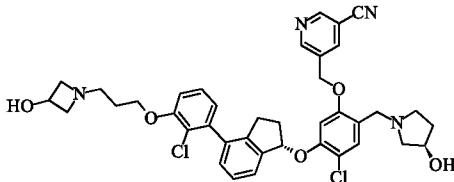
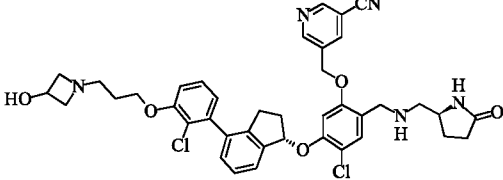


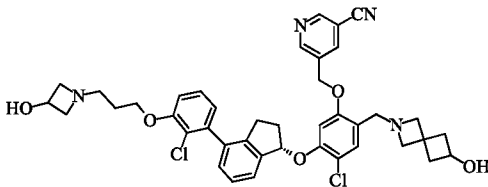
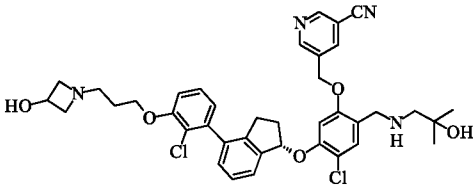
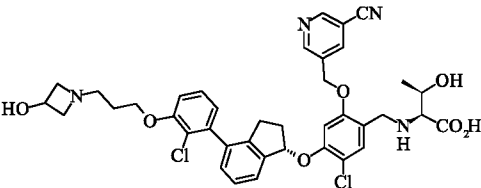
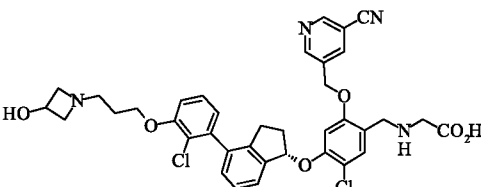
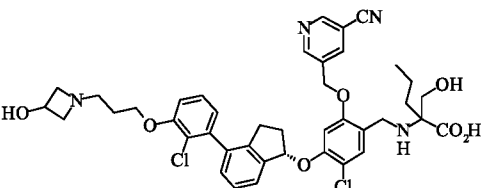
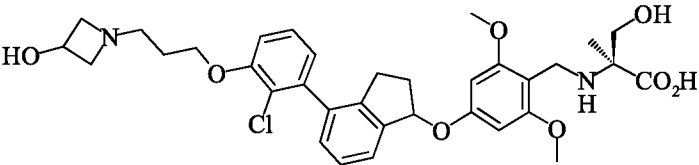
	+++	775.20	1.76
	++	677.10	1.56 <sup>#</sup>
	+++	765.20	1.83 <sup>#</sup>
	+++	767.10	1.76 <sup>#</sup>
	++	671.30	1.90
	+++	659.20	1.83

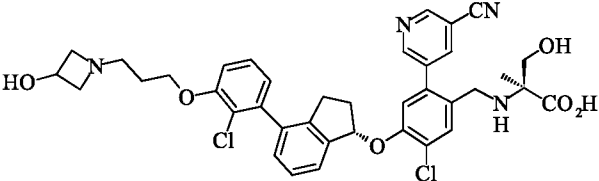
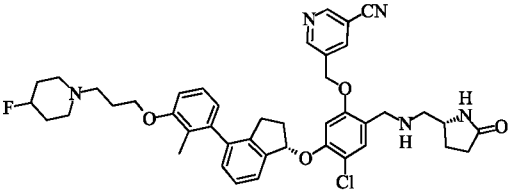
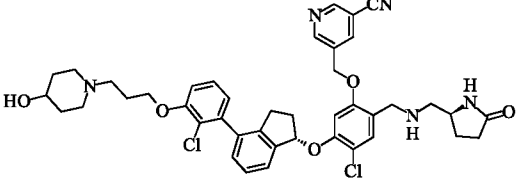
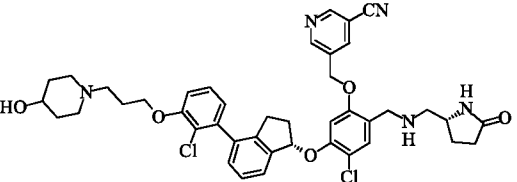
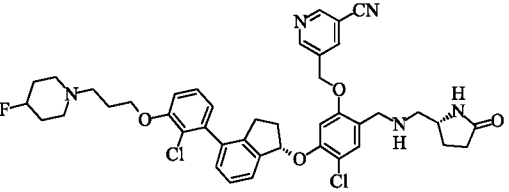
	+++	746.20	0.40
	+++	722.20	0.47
	+++	757.20	1.95
	+++	761.20	1.41
	+++	758.10	1.60

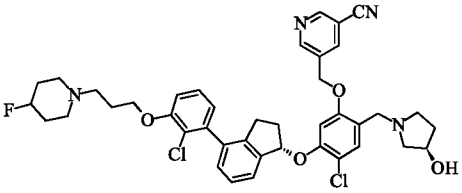
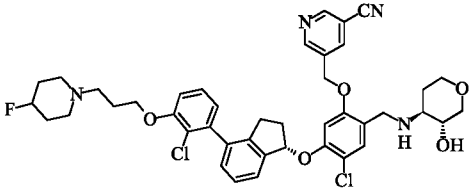
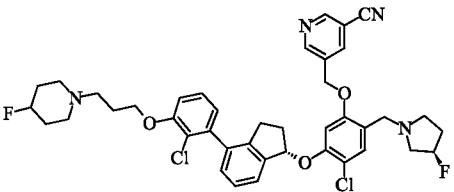
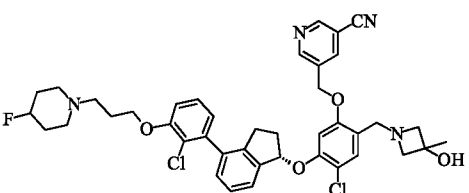
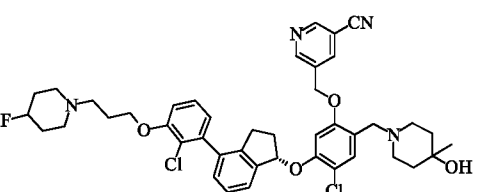
	+++	749.20	1.22
	+++	765.20	1.55
	+++	787.20	2.20
	+++	789.20	1.65
	+++	798.70	1.80

	++	783.20	1.60
	+++	743.20	1.80
	+++	772.20	1.81
	+++	824.10	1.85
	+++	701.10	1.95

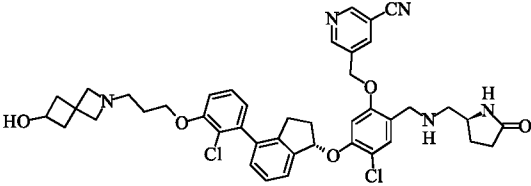
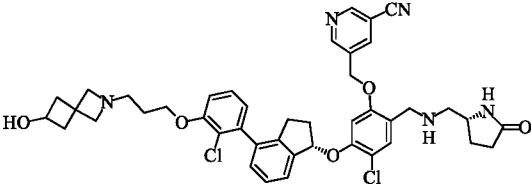
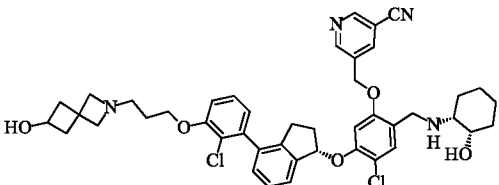
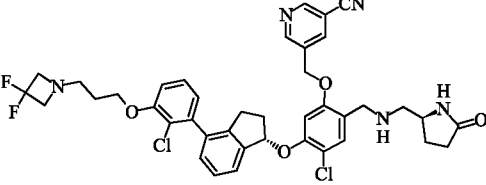
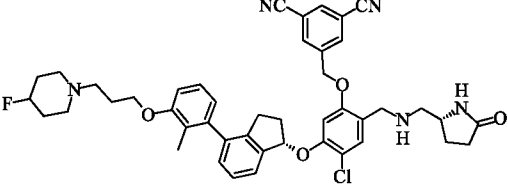
	+++	729.20	0.53
	+++	746.20	0.40
	+++	752.20	1.90
	+++	715.10	1.94
	+++	742.00	1.79

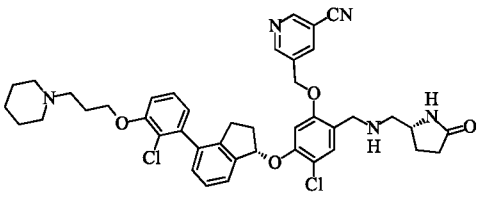
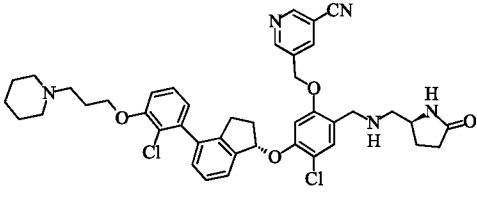
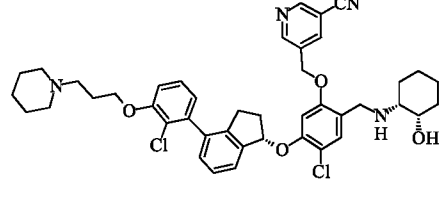
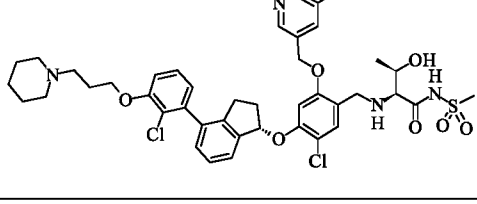
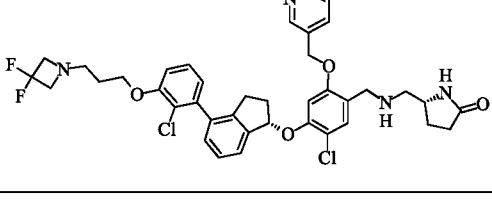
	+++	741.00	2.03
	+++	717.00	2.03
	+++	747.20	1.82
	+++	703.20	1.87
	+++	775.20	1.64
	++	641.20	2.68*

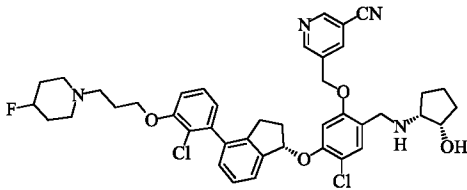
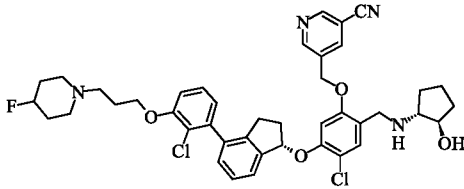
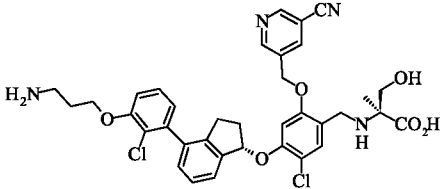
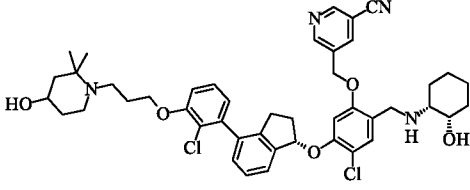
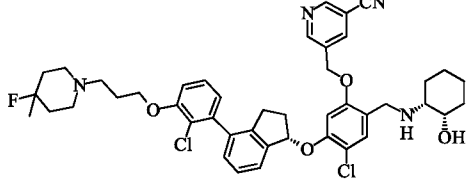
	+++	717.20	1.80
	+++	752.20	1.90
	+++	772.20	1.45
	+++	770.20	1.45
	+++	774.20	1.52

	+++	745.20	1.57
	+++	775.20	1.53
	+++	747.10	2.27
	+++	745.20	1.95
	+++	773.20	1.87

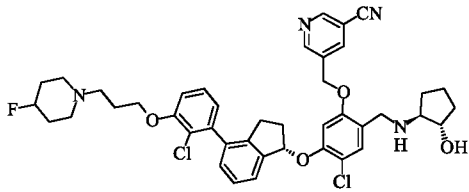
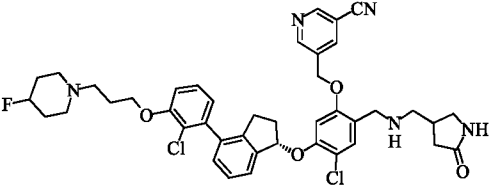
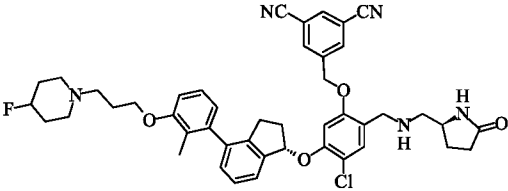
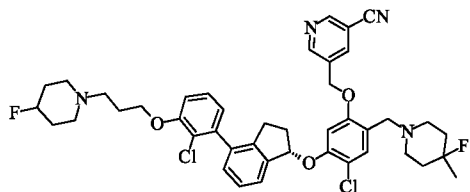
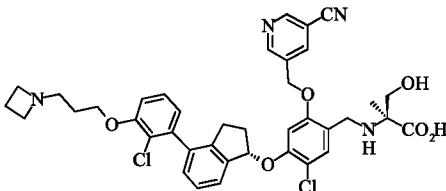


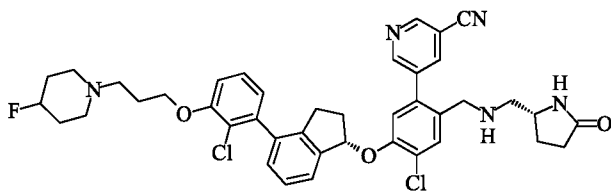
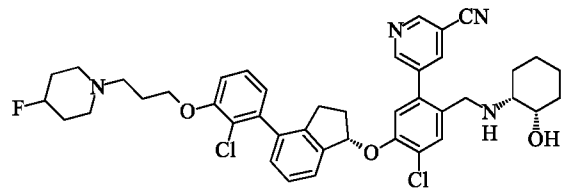
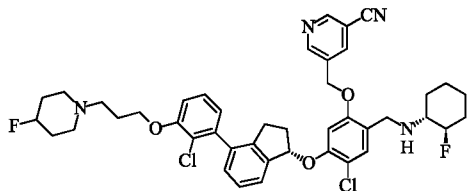
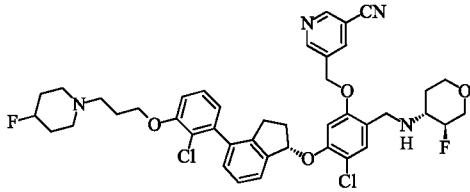
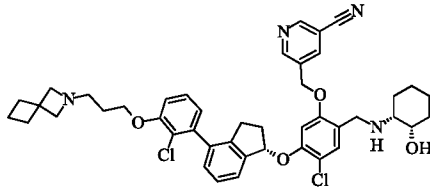
	+++	783.20	1.70
	+++	783.20	1.70
	+++	783.20	1.90
	++	762.20	1.70
	++	776.10	2.17

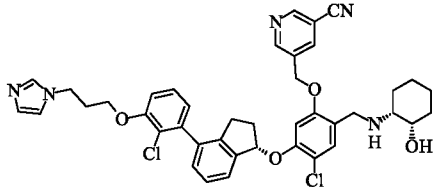
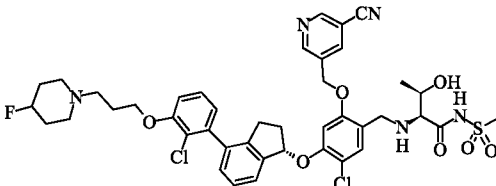
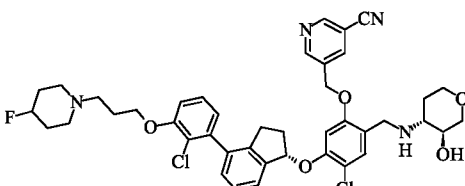
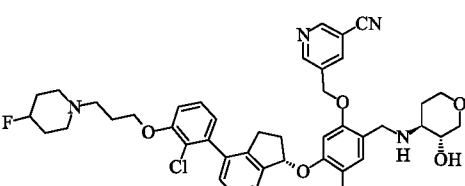
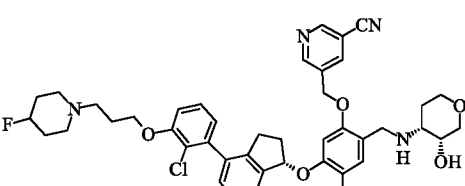
	+++	754.10	1.87
	+++	754.10	1.90
	+++	755.10	2.33
	+++	836.00	2.05
	++	762.20	1.70

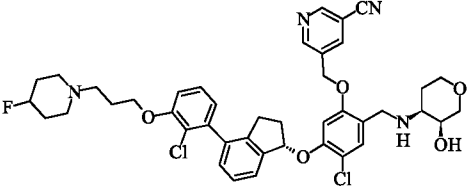
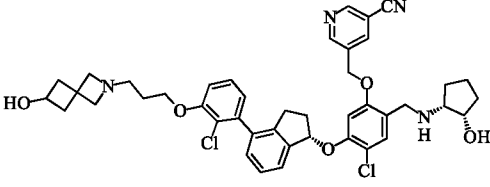
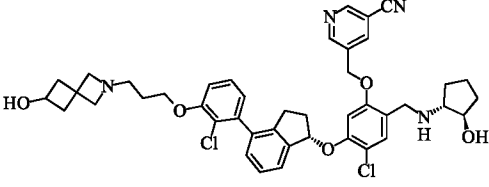
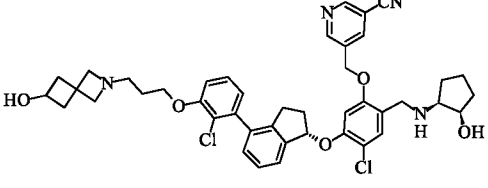
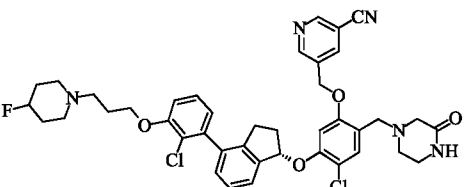
	+++	759.20	1.80
	+++	759.20	1.80
	+++	691.00	1.60
	+++	799.10	2.17
	+++	787.20	2.08

	+++	868.20	1.97
	++	687.20	1.69
	++	766.20	1.88
	+++	813.10	2.74
	+++	759.20	1.80

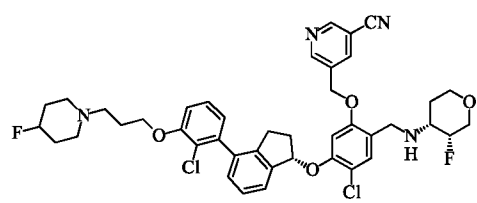
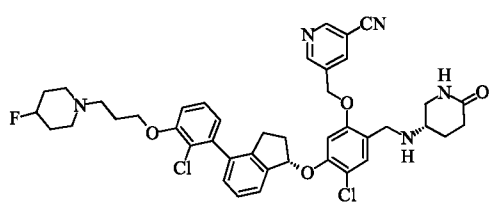
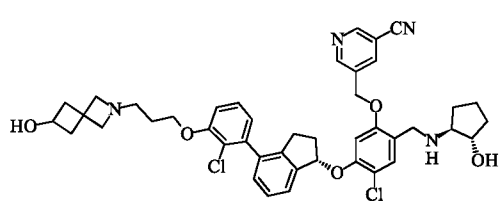
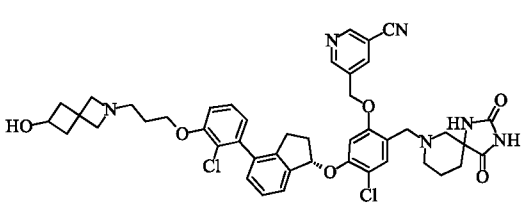
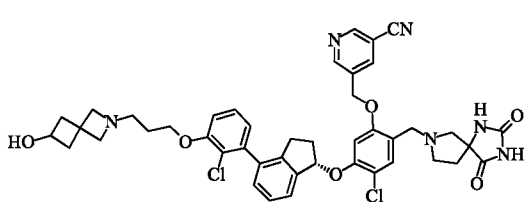
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	+++	776.20	1.92
	++	775.20	1.80
	+++	731.20	1.36

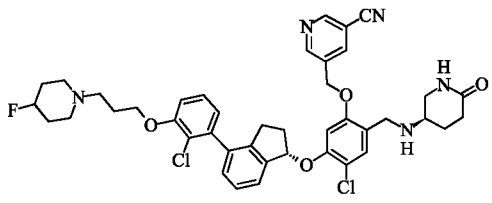
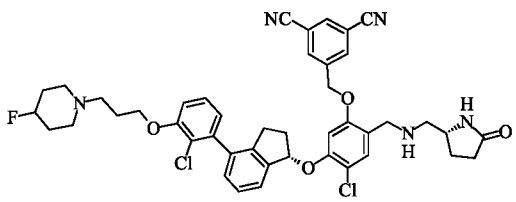
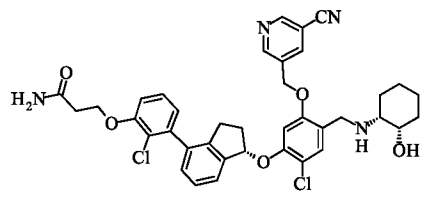
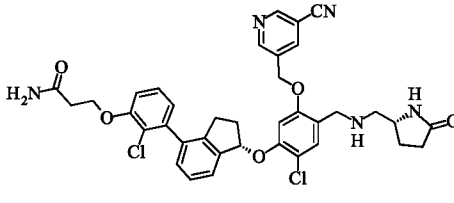
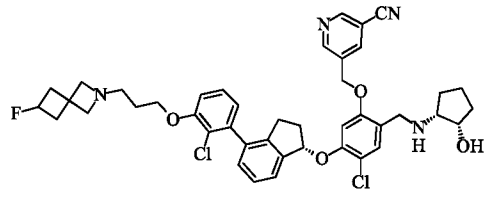
	+	742.20	1.66
	++	743.20	2.02
	++	775.20	3.26*
	++	777.20	3.06*
	+++	652.20	2.51

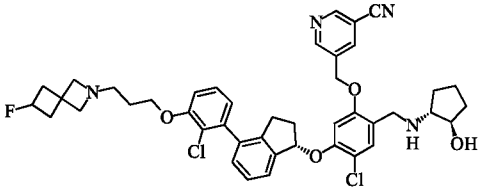
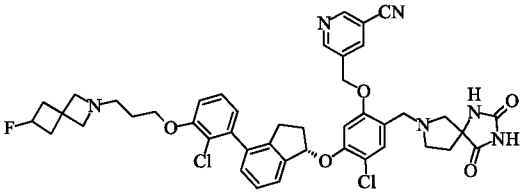
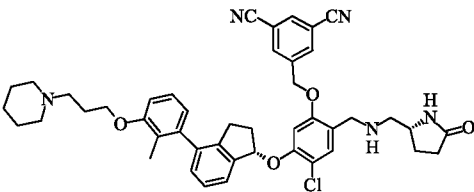
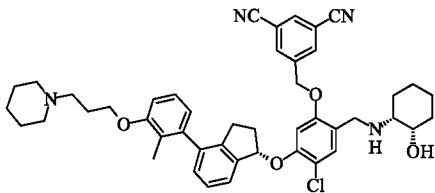
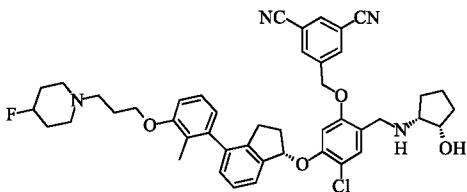
	++	738.20	2.27
	+++	854.10	2.09
	+++	775.20	2.06
	+++	775.20	2.23
	+++	775.20	2.27

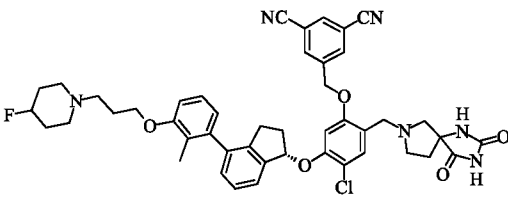
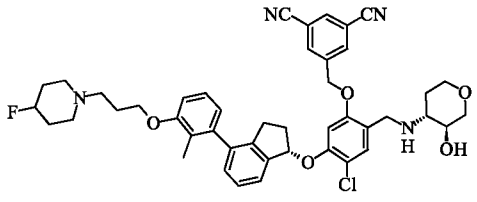
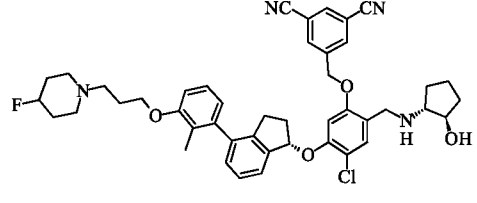
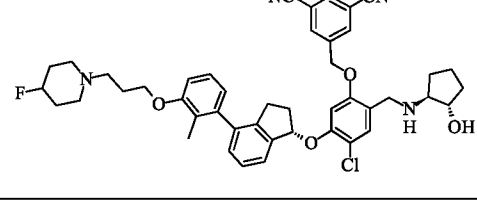
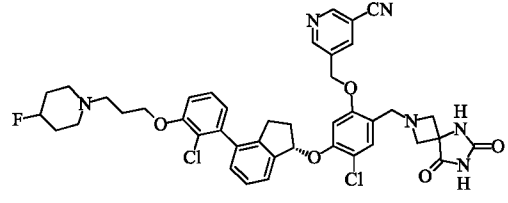
	+++	775.20	2.15
	+++	769.20	1.90
	+++	769.20	1.90
	+++	769.20	1.80
	++	758.20	2.30

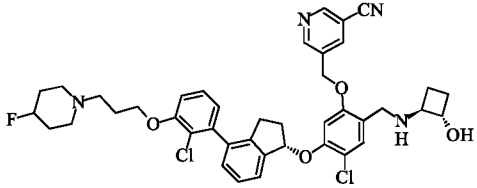
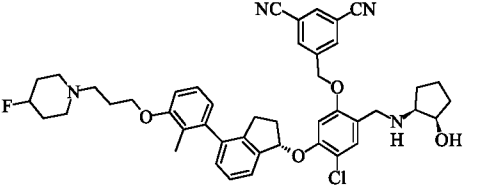
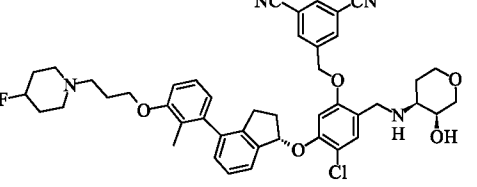
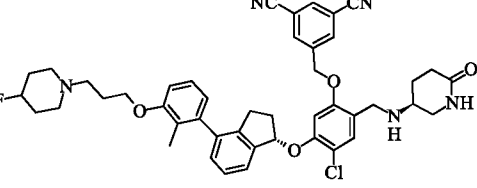
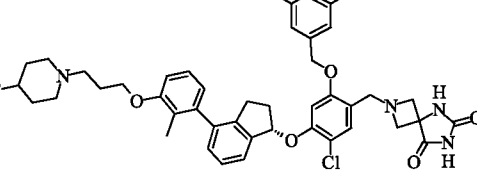


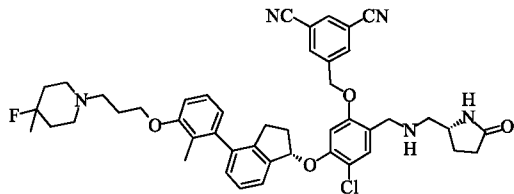
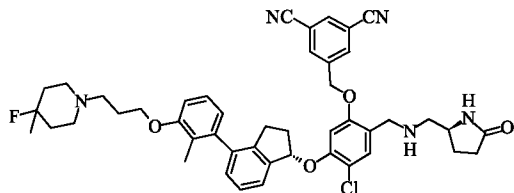
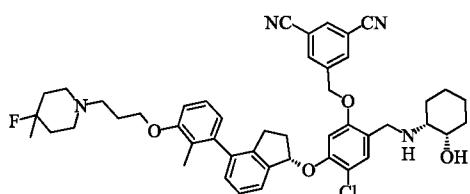
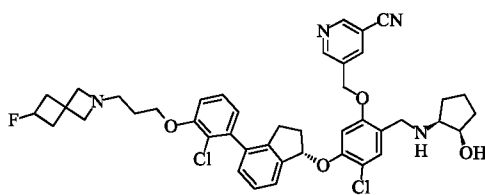
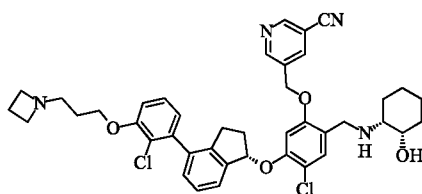
	++	777.20	2.95*
	+++	772.20	1.89
	+++	769.20	1.90
	++	837.20	1.90
	++	823.20	1.80

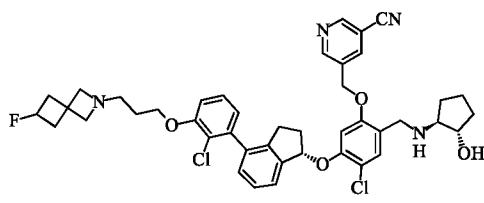
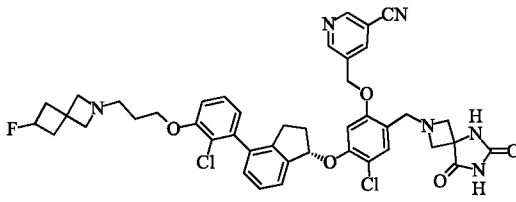
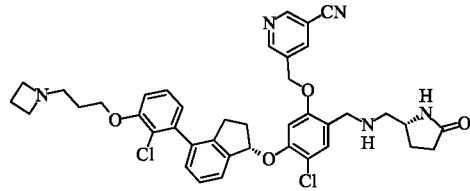
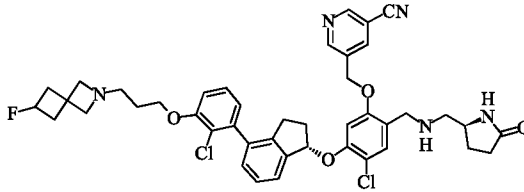
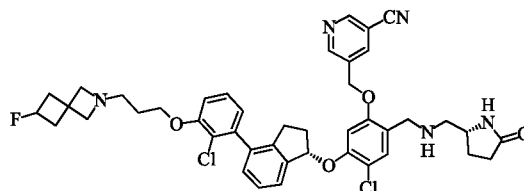
	+++	772.20	2.12
	+++	796.20	2.27
	++	701.20	1.53
	++	700.20	1.34
	+++	771.20	2.00

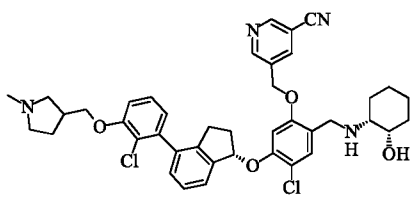
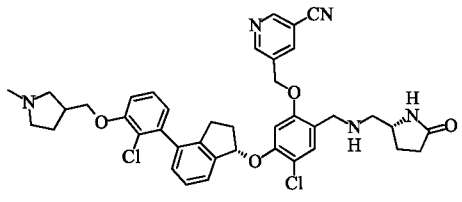
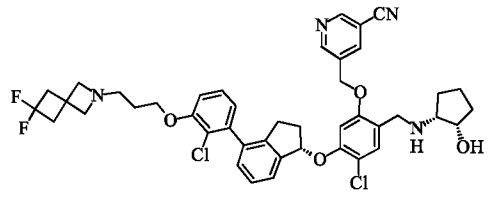
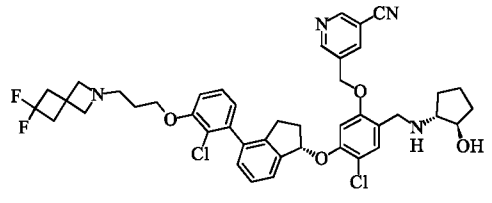
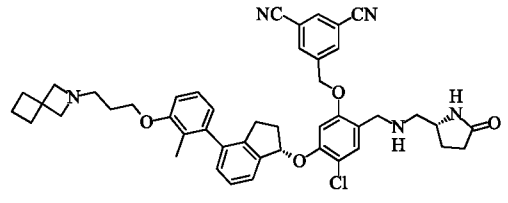
	+++	771.20	2.20
	++	825.20	2.10
	+++	758.30	2.23
	+++	759.20	2.69
	+++	763.20	2.08

	++	817.20	2.06
	+++	779.30	1.95
	+++	763.20	2.14
	+++	763.20	1.99
	+++	799.20	2.00

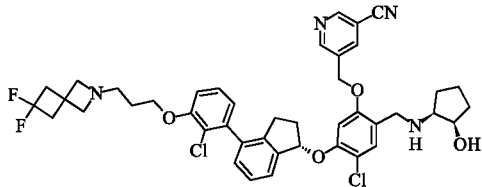
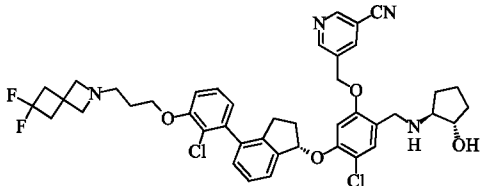
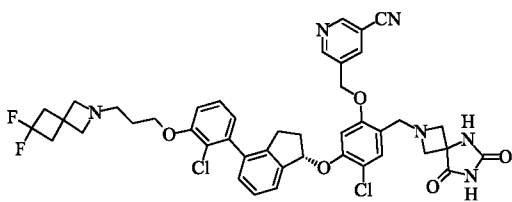
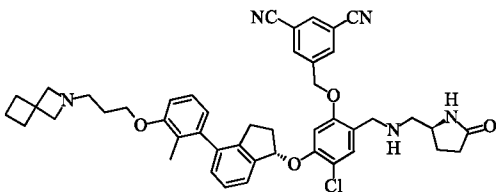
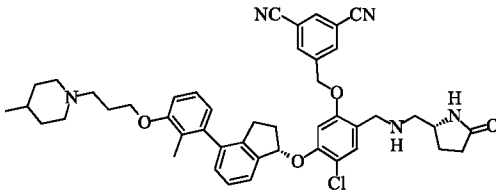
	+++	745.20	2.10
	+++	763.20	2.42
	+++	779.30	2.07
	++	776.20	2.29
	++	803.20	2.20

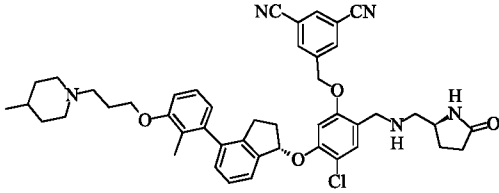
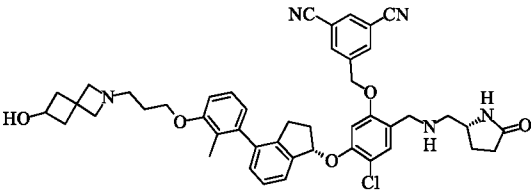
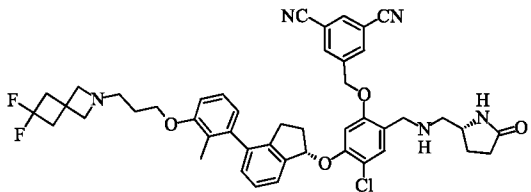
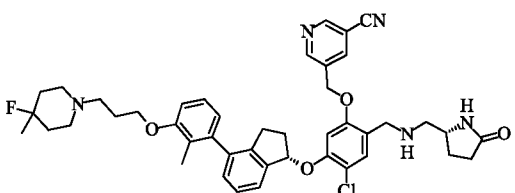
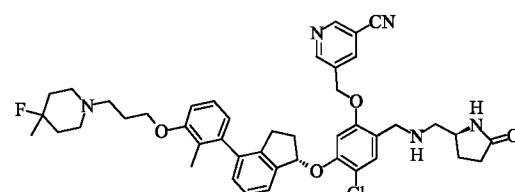
	++	790.20	2.38
	++	790.30	1.98
	++	757.30	2.20
	+++	771.20	2.20
	+++	727.20	2.15

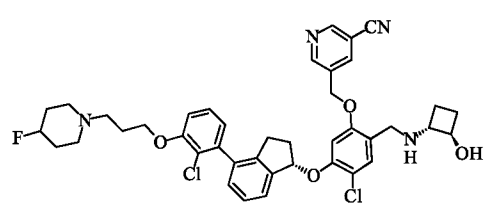
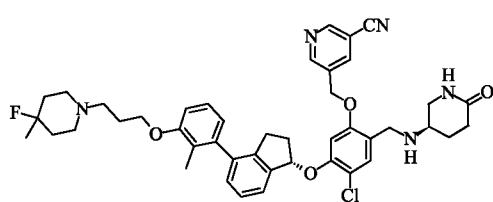
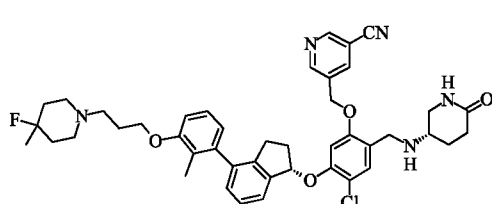
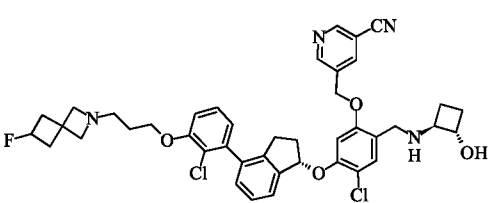
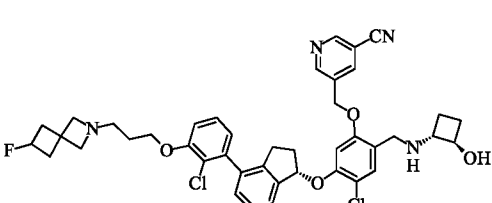
	+++	771.20	1.70
	++	811.20	1.70
	+++	726.20	1.95
	+++	784.20	2.00
	+++	784.20	2.00

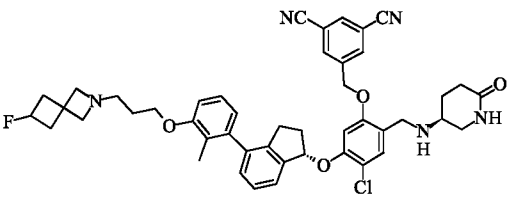
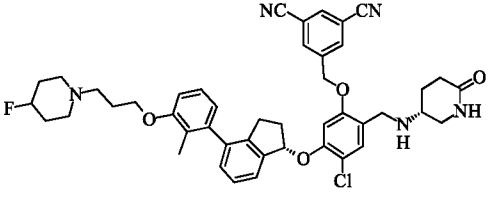
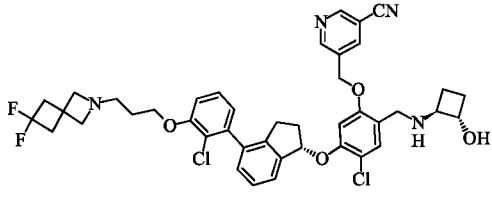
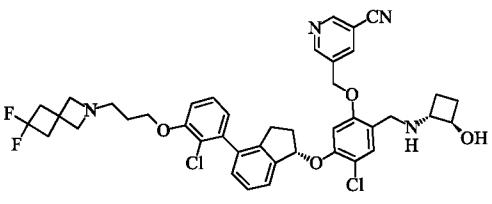
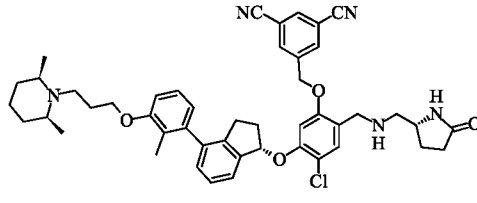
	+++	727.20	2.45
	+++	726.20	2.01
	+++	789.20	2.00
	+++	789.20	1.90
	++	770.20	2.58

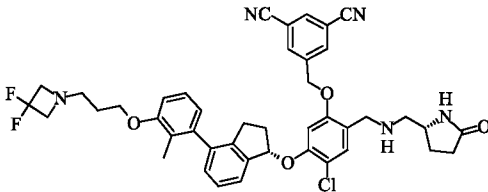
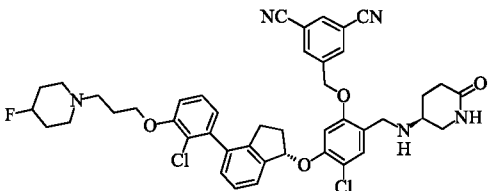
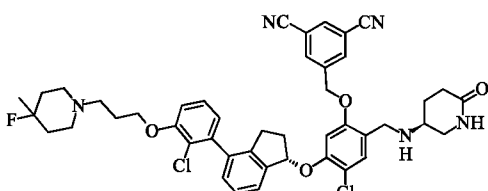
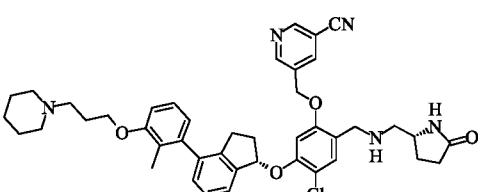
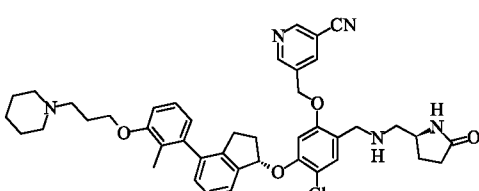


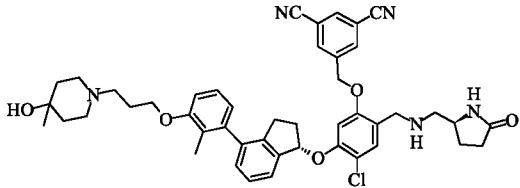
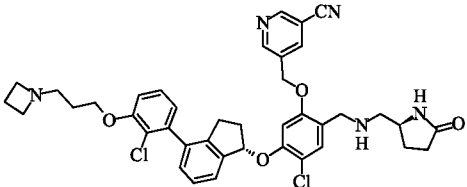
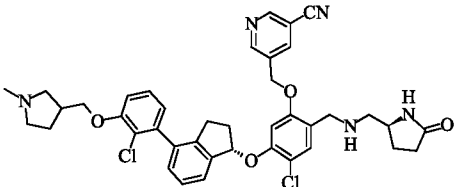
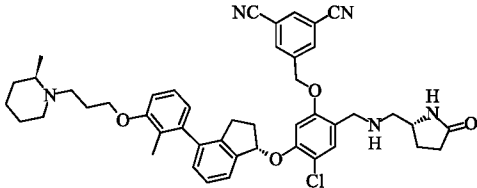
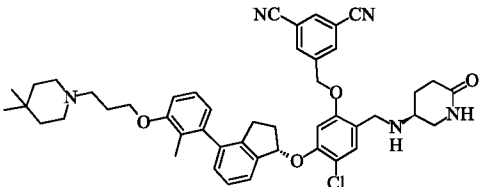
	+++	789.20	2.30
	+++	789.20	1.80
	++	829.00	2.00
	+++	770.10	2.62
	+++	772.20	2.51

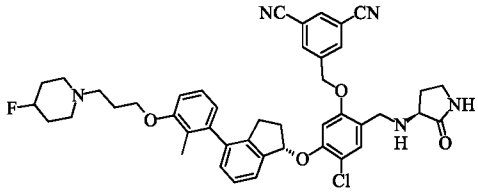
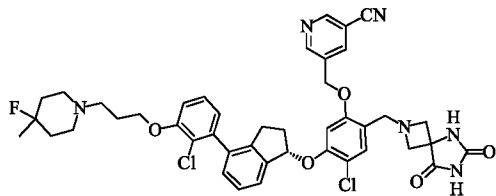
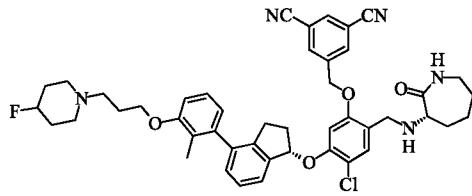
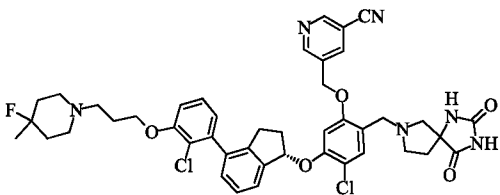
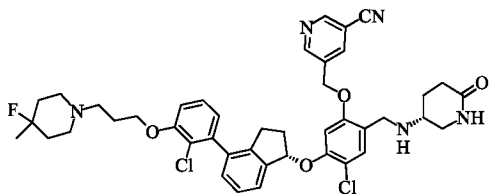
	+++	772.20	2.50
	+++	786.20	2.08
	++	806.30	1.84
	++	766.20	3.32*
	+++	766.20	3.37*

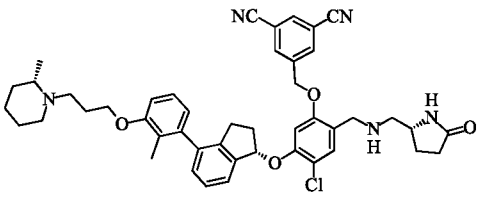
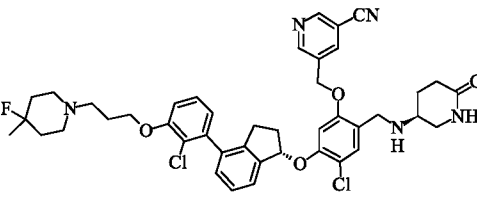
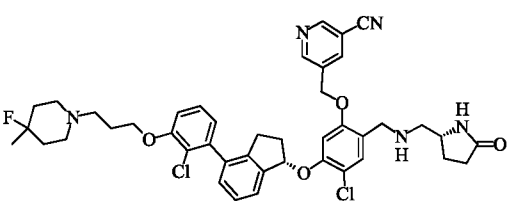
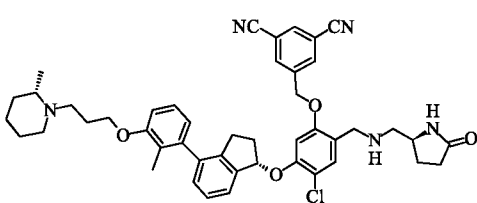
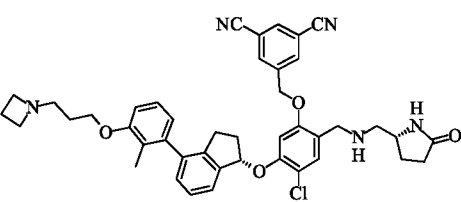
	+++	745.20	1.80
	+++	766.30	1.33
	++	766.20	1.30
	+++	757.20	2.00
	+++	757.20	1.80

	+++	788.20	2.44
	+++	776.20	1.88
	++	775.10	2.10
	+++	775.20	2.00
	++	786.30	2.43

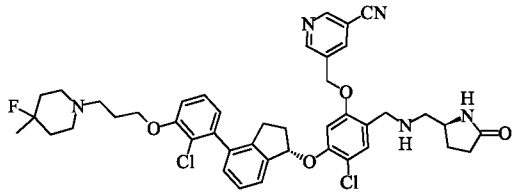
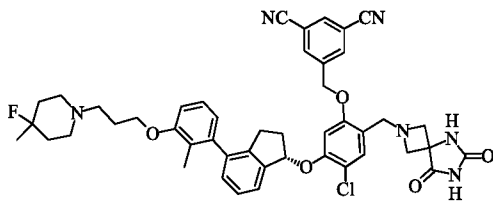
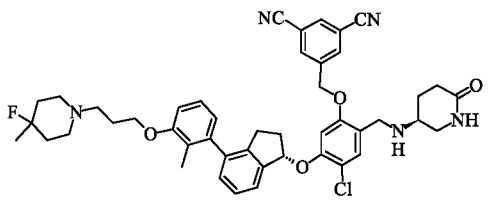
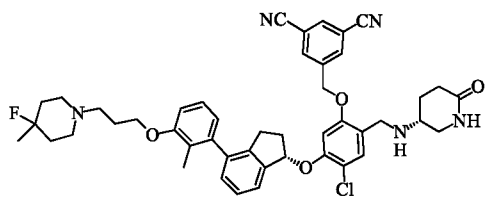
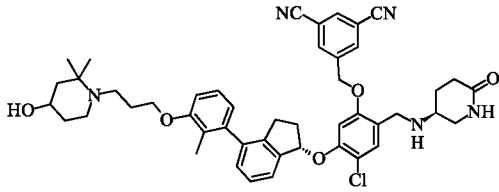
	++	766.20	2.19
	++	796.20	1.86
	++	810.20	2.10
	+++	734.20	3.12*
	+++	734.20	3.26*

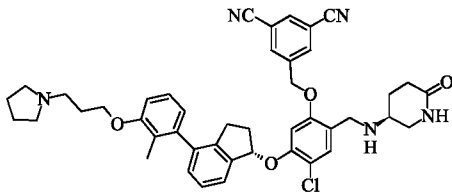
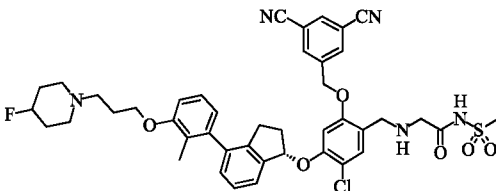
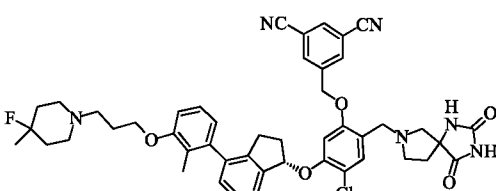
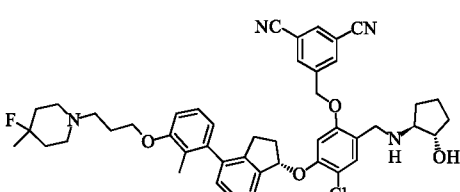
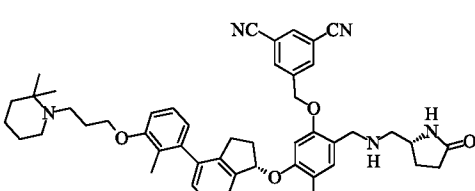
	+++	788.30	1.92*
	+++	726.20	2.02
	+++	726.20	1.94
	+++	772.20	2.16
	++	786.30	2.11

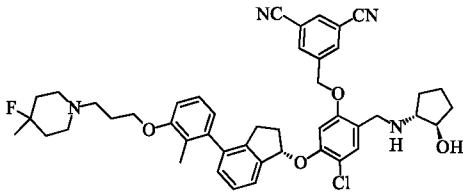
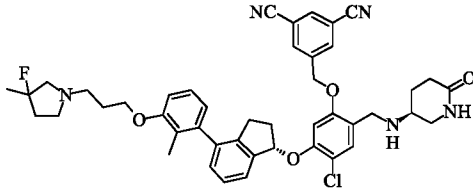
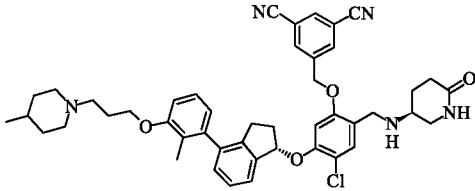
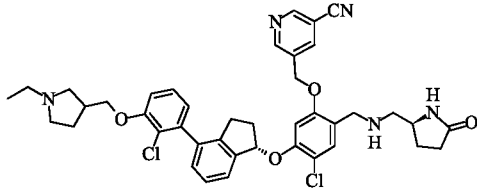
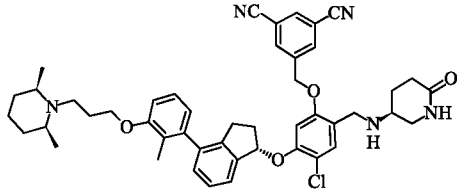
	++	762.20	1.92
	++	813.00	2.20
	++	790.20	2.21
	++	827.20	2.00
	++	786.20	1.70

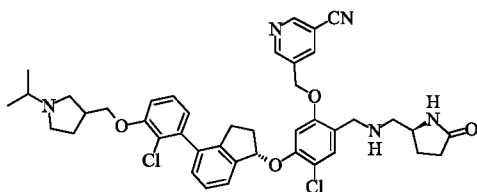
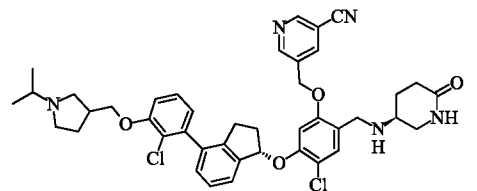
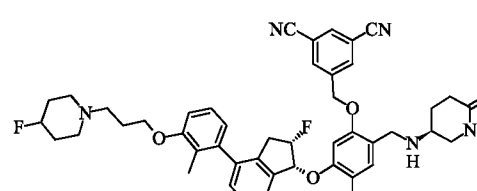
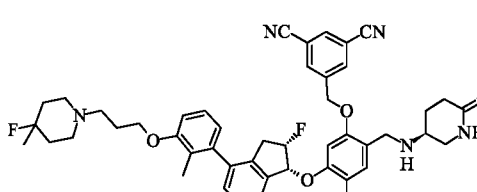
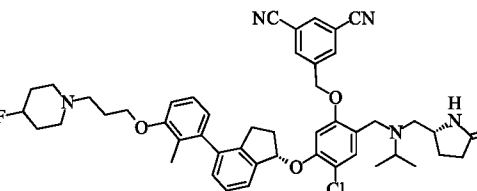
	++	772.20	2.38
	++	787.20	1.90
	++	786.20	1.90
	+++	772.30	2.58
	+++	730.20	2.15

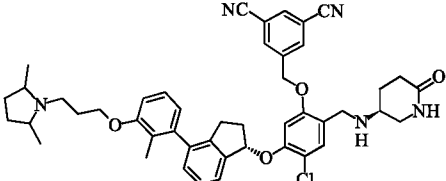
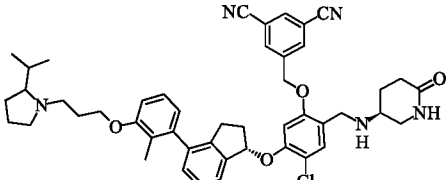
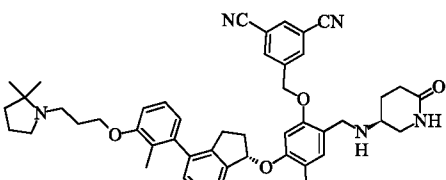
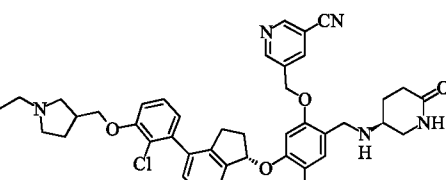
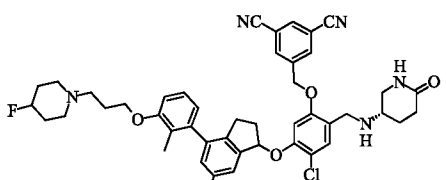


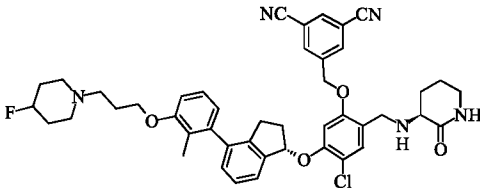
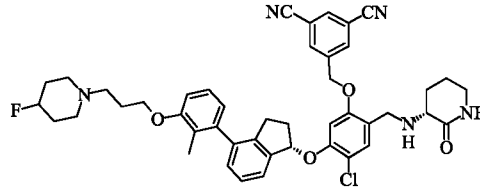
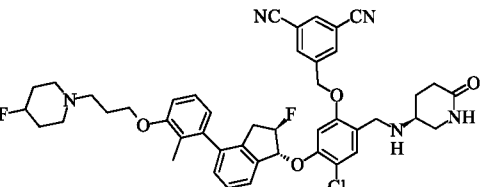
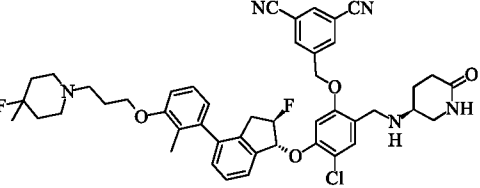
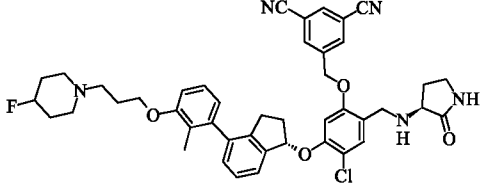
	+++	786.10	2.20
	+	817.20	2.00
	++	790.20	2.00
	++	790.30	2.00
	+++	802.20	1.96

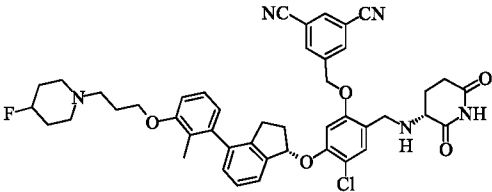
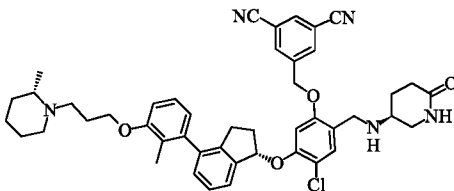
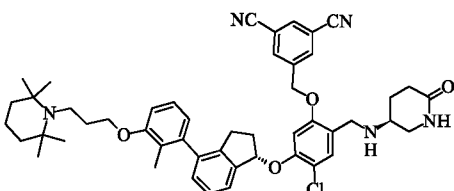
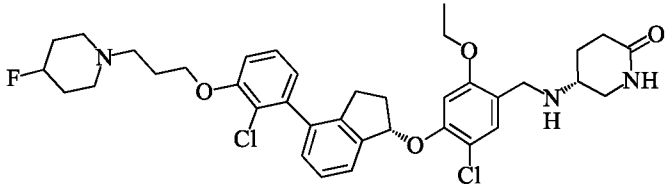
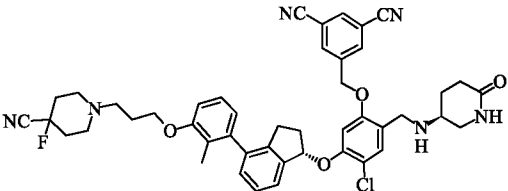
	+++	744.30	2.02
	+++	814.20	2.20
	++	831.30	2.20
	++	777.30	2.00
	++	786.30	2.25

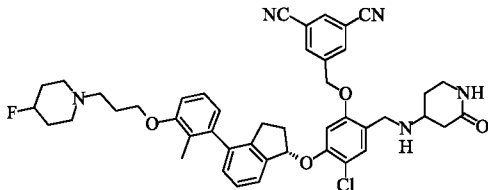
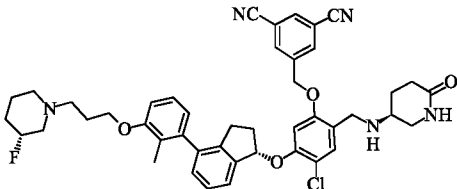
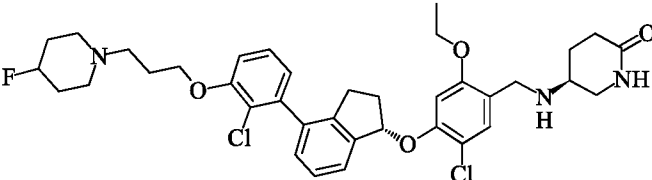
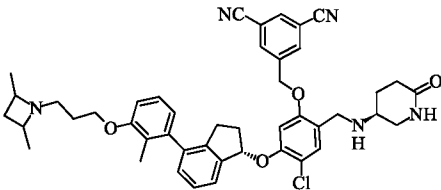
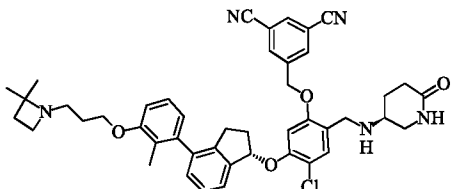
	++	778.40	2.40
	++	776.20	2.00
	++	773.90	1.80
	+++	739.80	1.77
	++	787.90	1.80

	+++	753.80	0.45
	+++	754.20	2.15
	++	794.20	1.92 <sup>#</sup>
	++	808.20	1.99 <sup>#</sup>
	++	878.20	2.95 <sup>*</sup>

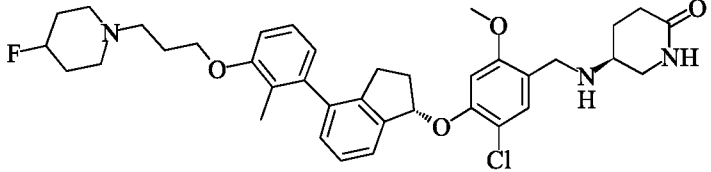
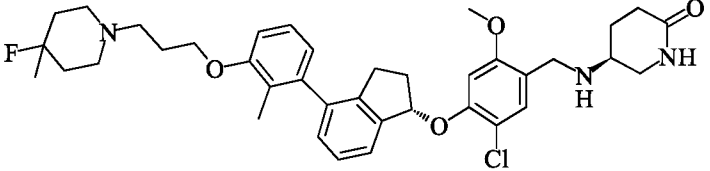
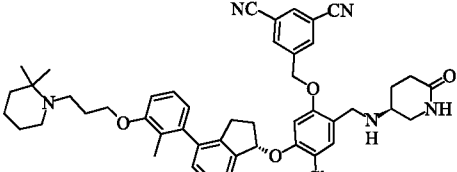
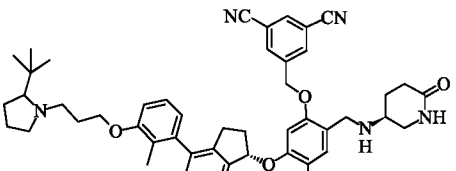
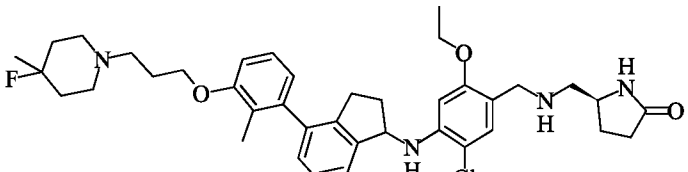
	+++	773.90	2.00
	++	787.90	1.70
	+++	771.90	1.80
	+++	740.10	1.86
	++	794.20	1.93

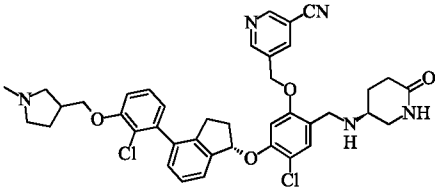
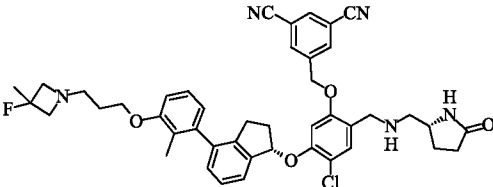
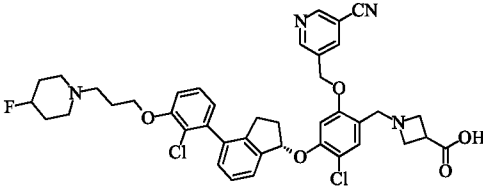
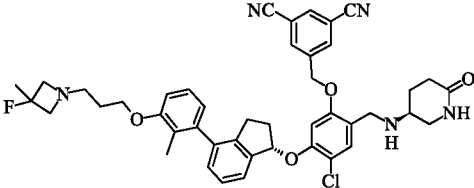
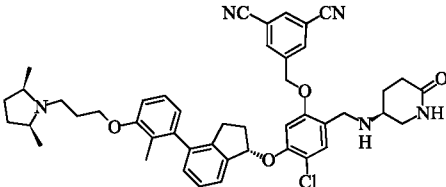
	++	776.20	1.86
	++	776.20	1.88
	++	793.80	1.88 <sup>s</sup>
	++	807.80	1.91 <sup>s</sup>
	++	762.20	1.75

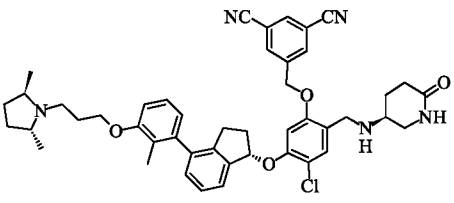
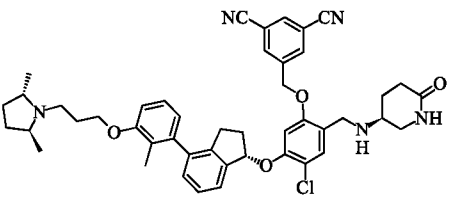
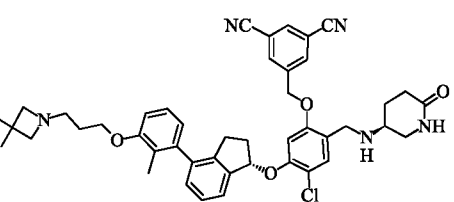
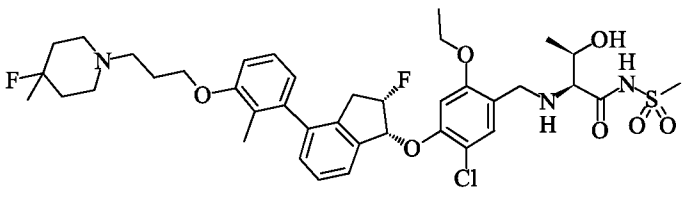
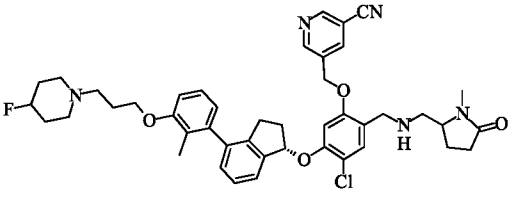
	++	790.20	1.76
	+++	773.90	1.90
	++	813.90	2.10
	++	684.20	1.71
	++	800.80	1.90

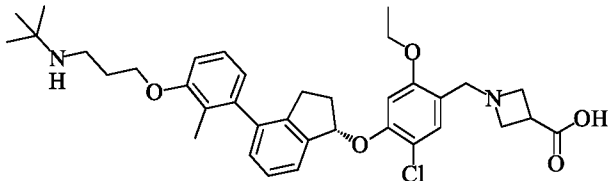
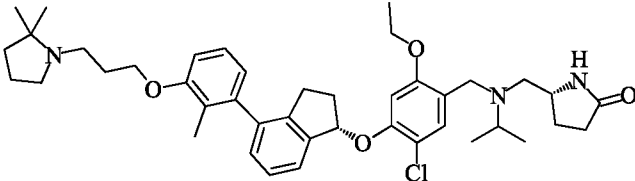
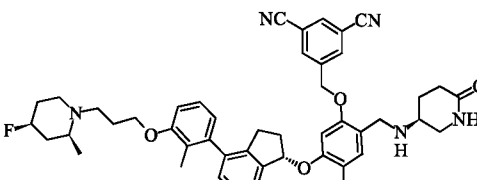
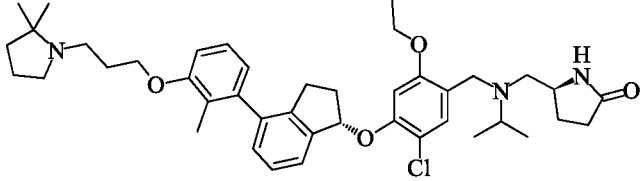
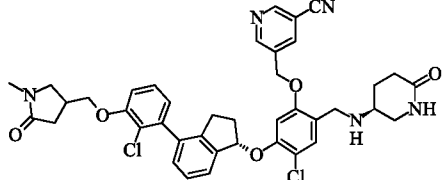
	+++	775.90	1.77
	++	775.90	1.70
	++	684.20	1.77
	+++	757.90	2.00
	+++	759.90	1.90

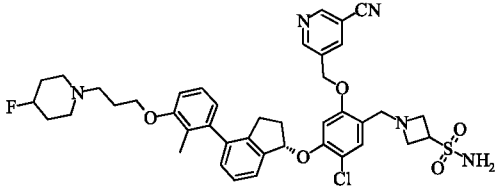
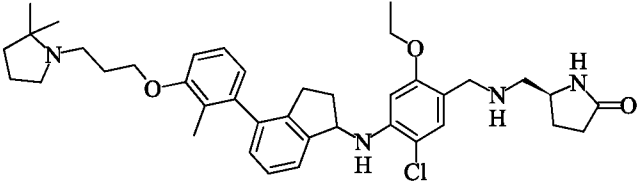
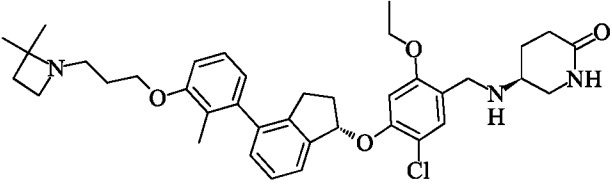
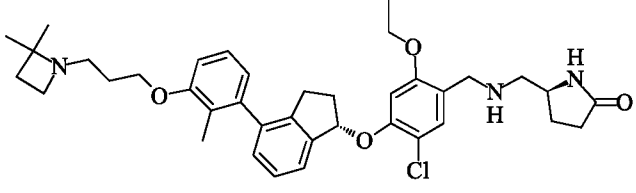
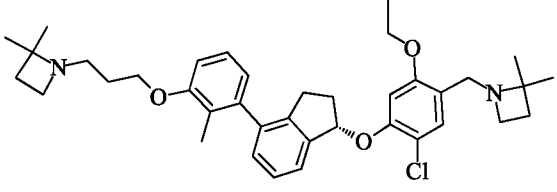


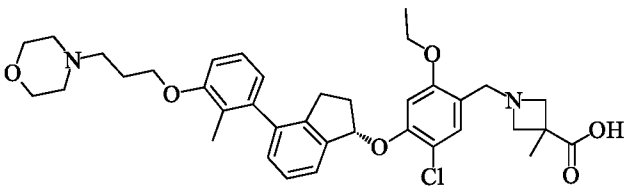
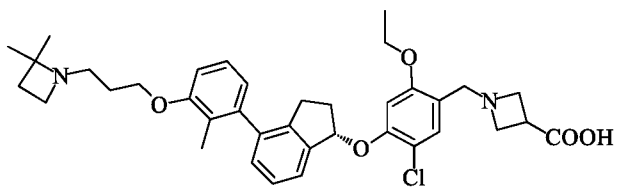
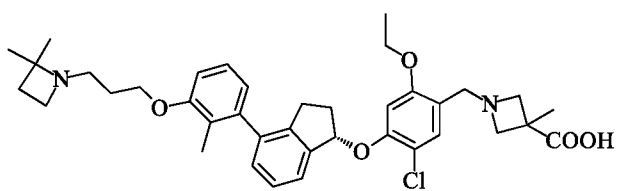
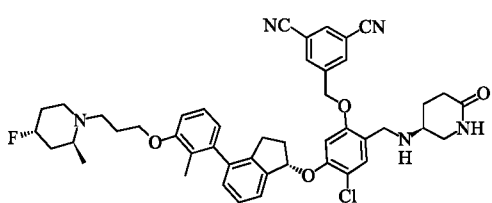
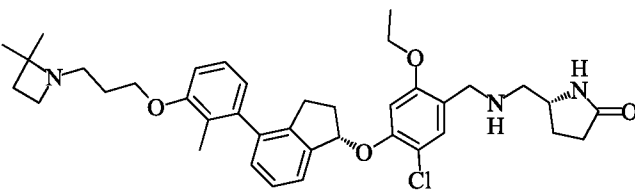
	++	650.30	1.71
	++	664.20	1.74
	++	785.90	1.90
	++	800.90	2.00
	++	677.20	1.79

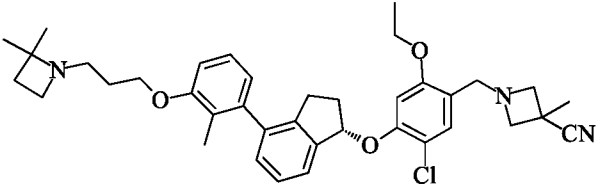
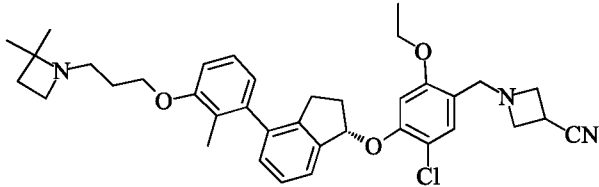
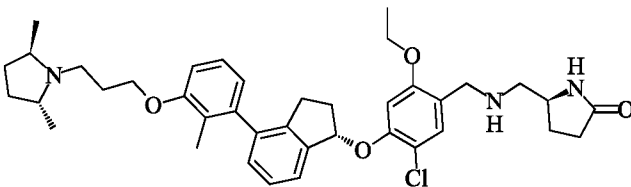
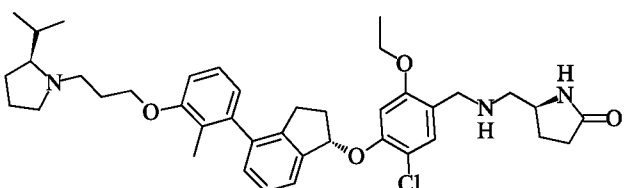
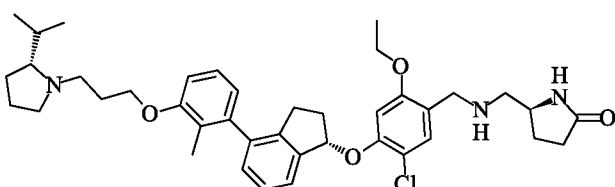
	++	726.20	1.75
	++	762.20	1.90
	+++	759.10	2.33
	++	762.20	1.91
	+++	773.90	2.00

	+++	773.90	2.00
	+++	773.90	2.00
	+++	757.90	1.90
	++	778.20	1.94 <sup>#</sup>
	++	766.20	1.87 <sup>*</sup>

	++	621.30	1.74*
	+	706.20	1.93
	++	789.80	1.90
	++	702.30	1.68
	++	740.10	2.05

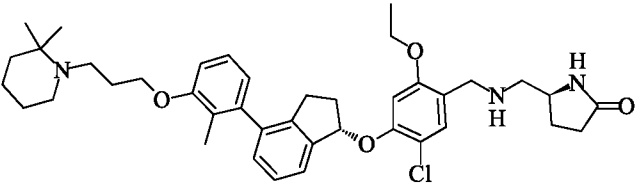
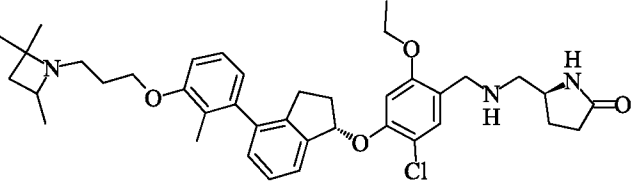
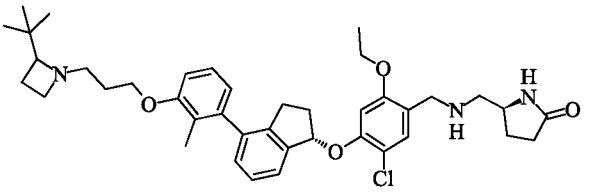
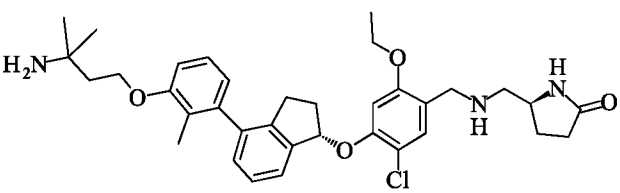
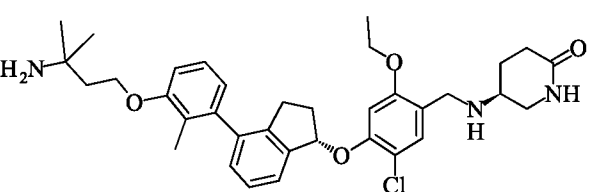
	++	774.20	2.13
	++	659.20	1.91
	++	646.00	1.90
	+++	646.00	1.80
	++	617.00	2.10

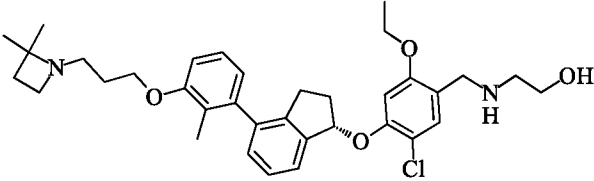
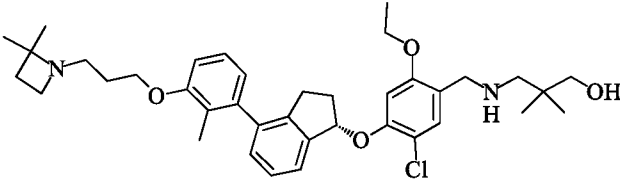
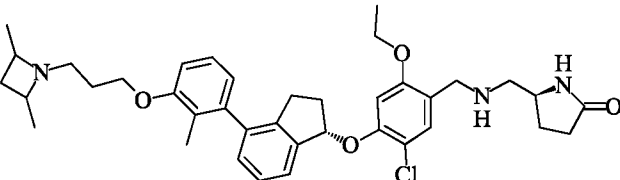
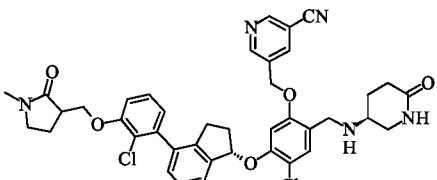
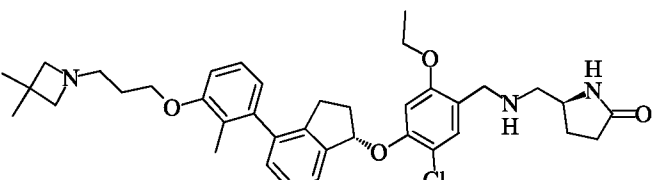
	++	649.20	1.71
	++	633.20	1.82
	++	647.20	1.83
	++	790.80	1.90
	++	646.00	1.90

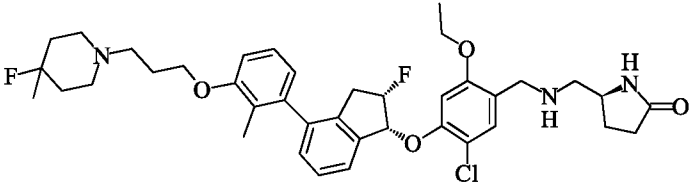
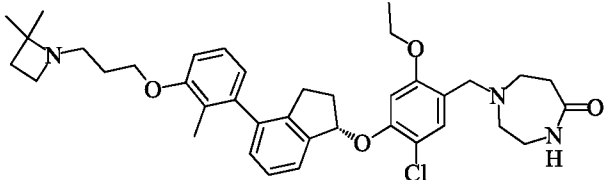
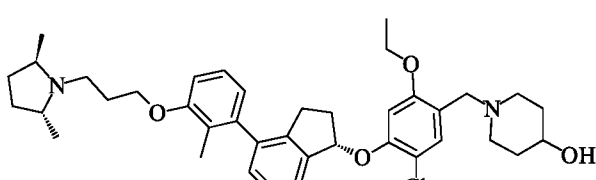
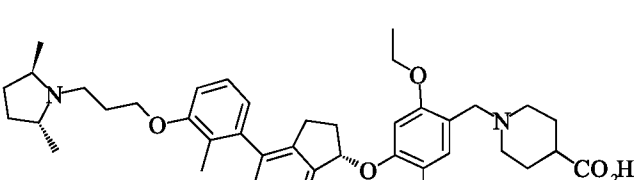
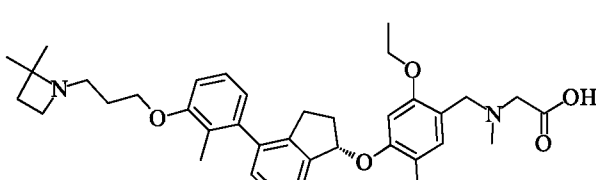
	++	628.20	1.97
	++	614.20	1.92
	+++	660.00	1.90
	++	674.00	1.90
	+++	674.00	2.00

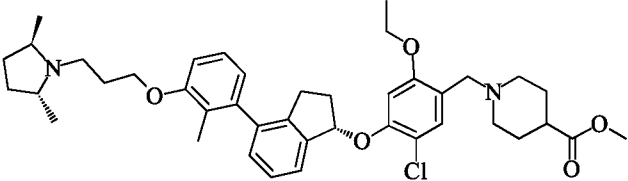
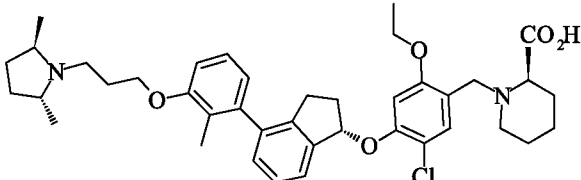
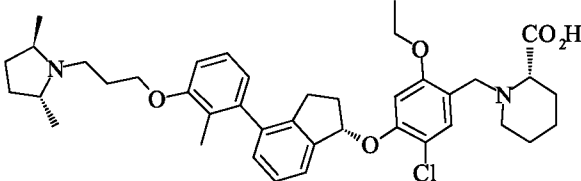
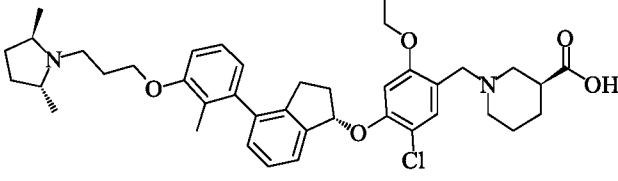
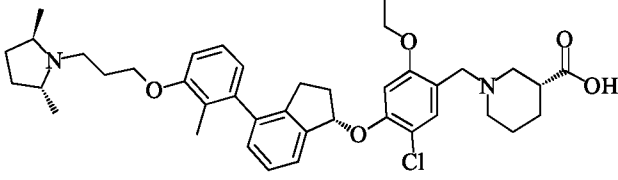
	+++	648.30	1.82
	++	660.30	1.89
	++	661.20	1.95
	+++	634.20	1.81
	+++	660.00	1.80

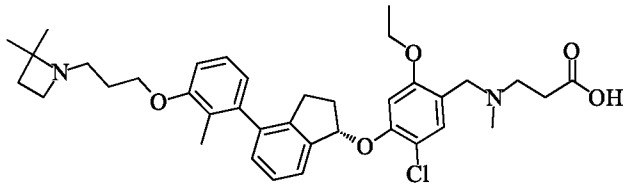
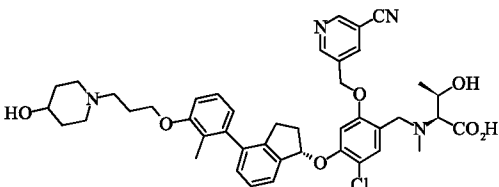
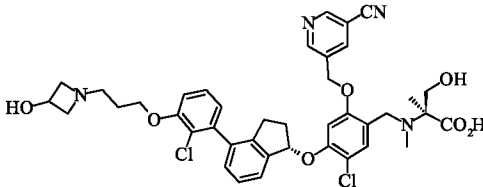
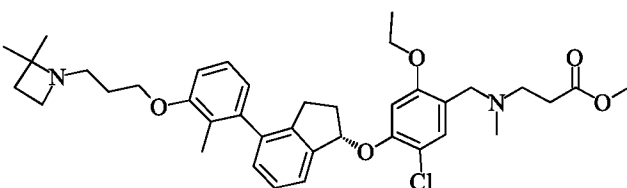
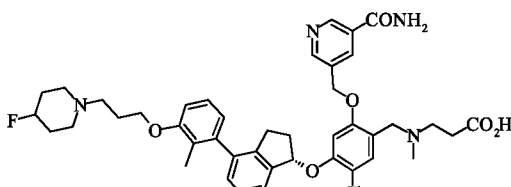


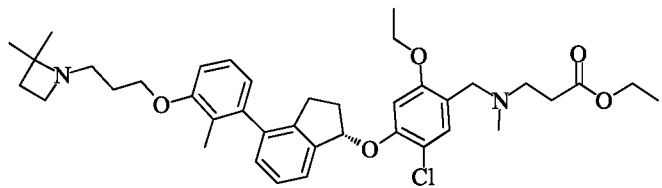
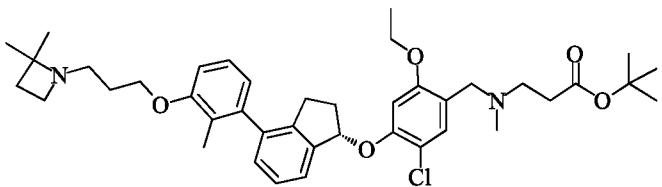
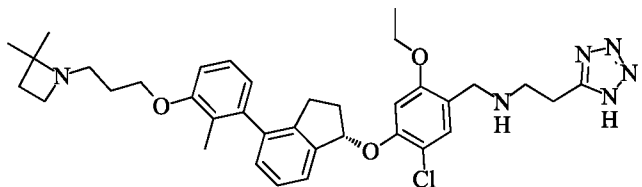
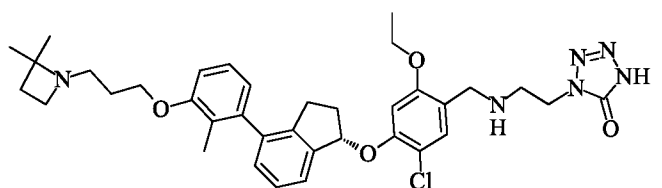
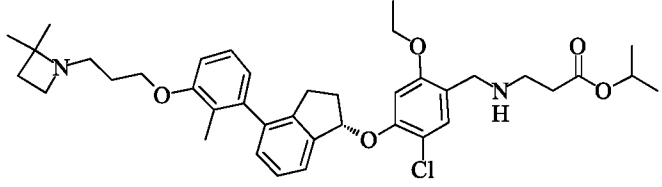
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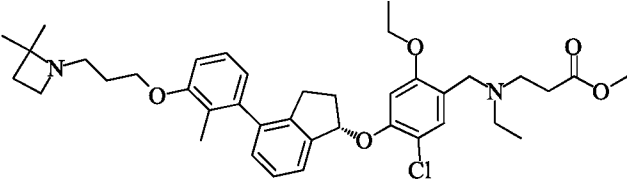
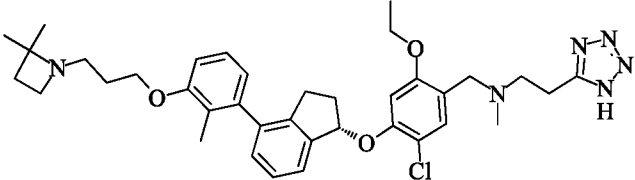
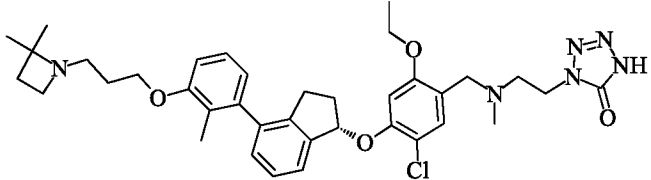
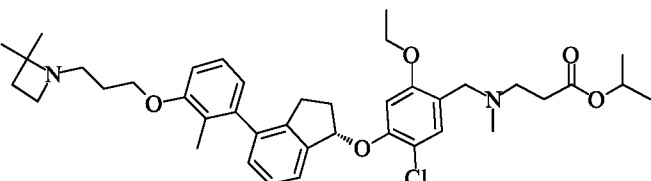
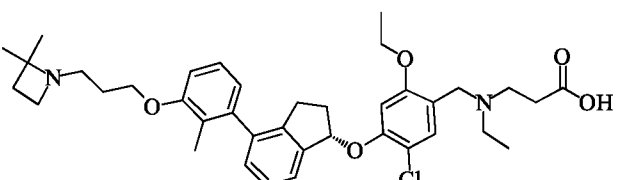
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	++	696.20	2.04 <sup>#</sup>
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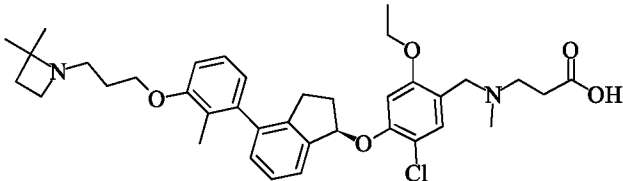
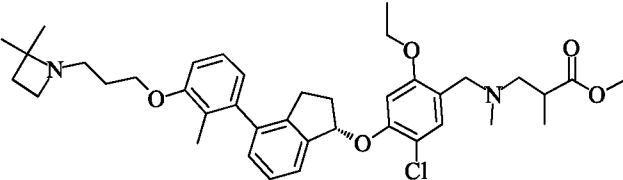
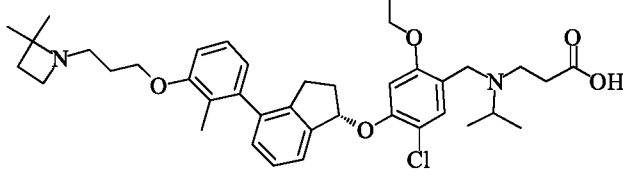
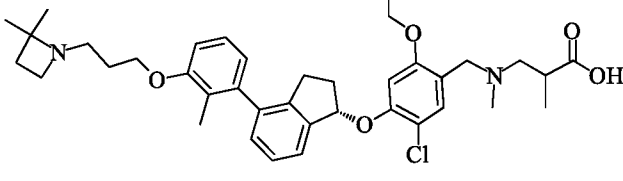
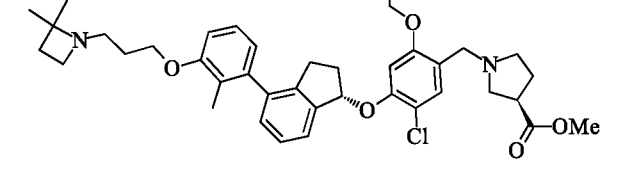
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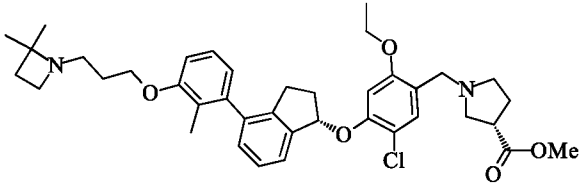
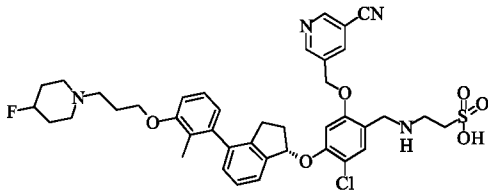
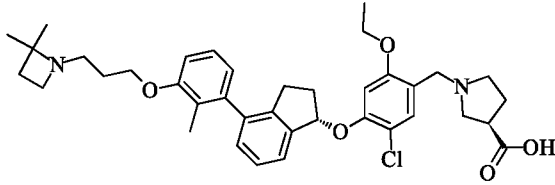
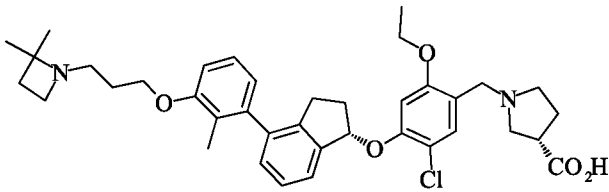
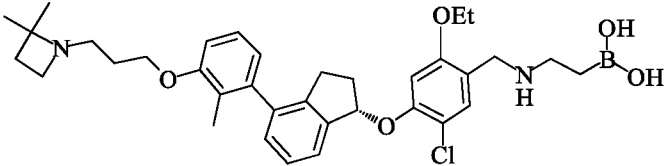
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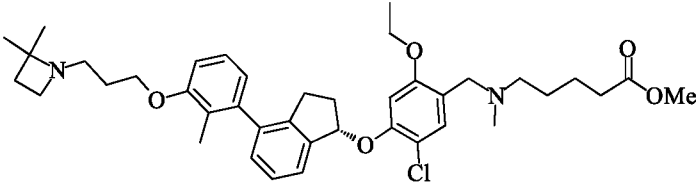
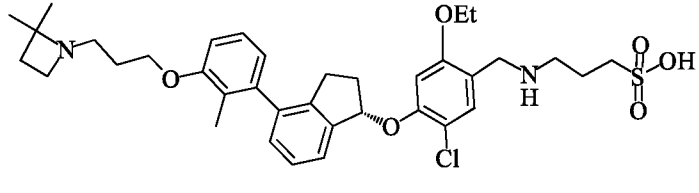
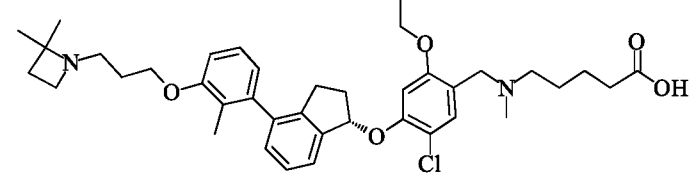
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	++	675.30	1.70
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	++	663.40	1.70
	+++	651.40	1.80
	++	665.50	1.80
	++	649.40	1.80
	++	657.30	2.45*



	+	635.40	1.70
	+	663.40	1.80
	++	663.30	1.80
	++	649.40	1.80
	++	661.40	1.70

	++	661.40	1.60
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	++	648.40	1.80
	++	621.30	2.36*

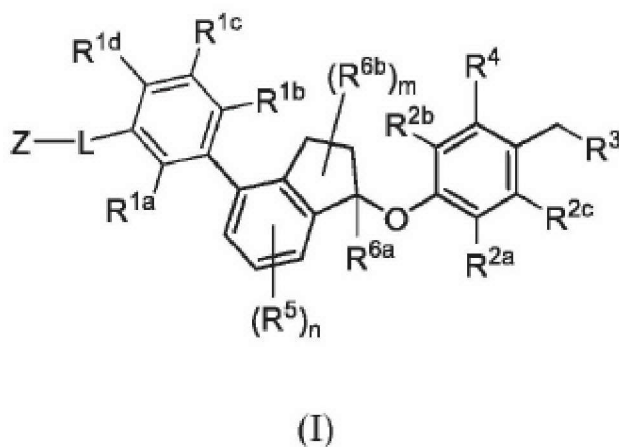
	++	677.20	1.70
	++	671.30	2.49*
	++	663.30	1.80

#Relative *cis* isomer corresponding to F-indane ether

\$Relative *trans* isomer corresponding to F-indane ether

**We Claim:**

1. A compound of Formula (I)



or a pharmaceutically acceptable salt thereof;

- 5 wherein:

each of  $R^{1a}$ ,  $R^{1b}$ ,  $R^{1c}$  and  $R^{1d}$  is independently selected from the group consisting of H, halogen,  $CF_3$ , CN,  $C_{1-4}$  alkyl and  $-O-C_{1-4}$  alkyl;

L is a linking group selected from the group consisting of:



- 10 wherein each of the subscripts q is independently 1, 2, 3 or 4, and L is optionally further substituted with one or two members selected from the group consisting of halogen, hydroxy,  $C_{1-3}$  alkyl,  $-O-C_{1-3}$  alkyl,  $C_{1-3}$  hydroxyalkyl,  $C_{1-3}$  haloalkyl and  $-CO_2H$ ;

- 15 Z is selected from the group consisting of azetidiny, pyrrolidiny, piperidiny, piperazinyl, morpholinyl, pyridyl, pyrimidinyl, imidazolyl, guanidinyl, quinuclidine, 2-azaspiro[3.3]heptane and 8-azabicyclo[3.2.1]octane, each of which is optionally substituted with from 1 to 4 groups independently selected from halogen, CN, hydroxy, oxo,  $C_{1-4}$  alkyl,  $-NH_2$ ,  $-NHC_{1-3}$ alkyl,  $-N(C_{1-3}alkyl)_2$ ,  $-O-C_{1-3}$  alkyl,  $C_{1-3}$  hydroxyalkyl,  $C_{1-3}$  haloalkyl,  $-OC(O)(C_{1-4}$  alkyl),  $-CO_2(C_{1-4}$  alkyl) and  $-CO_2H$ ;

or

Z is  $-NR^aR^b$ ; wherein  $R^a$  is selected from the group consisting of H, C<sub>1-8</sub> alkyl, C<sub>1-8</sub> haloalkyl and C<sub>1-8</sub> hydroxyalkyl; and  $R^b$  is selected from H, -C<sub>1-8</sub> alkyl, and C<sub>1-8</sub> haloalkyl;

$R^{2b}$  and  $R^{2c}$  are both H and  $R^{2a}$  is halogen ;

$R^3$  is selected from the group consisting of  $-NR^gR^h$  and C<sub>4-12</sub> heterocyclyl, wherein the C<sub>4-12</sub> heterocyclyl is optionally substituted with 1 to 6  $R^{3a}$ ;

each  $R^{3a}$  is independently selected from the group consisting of halogen, -CN,

oxo,  $-OR^i$ ,  $-CO_2R^j$ ,  $-CONR^jR^k$ ,  $-CONHC_{1-6}$  alkyl-OH,  $-C(O)R^j$ ,  $-OC(O)NR^jR^k$ ,

$-NR^jC(O)R^k$ ,  $-NR^jC(O)_2R^k$ ,  $-CONHOH$ ,  $-PO_3H_2$ ,  $-NR^j-X^3C(O)_2R^k$ ,

$-NR^jC(O)NR^jR^k$ ,  $-NR^jR^k$ ,  $-OR^j$ ,  $-S(O)_2NR^jR^k$ ,  $-OX^3-R^j$ ,  $-OX^3-NR^jR^k$ ,

$-O-X^3-CO_2R^j$ ,  $-O-X^3-CONR^jR^k$ ,  $-X^3-OR^j$ ,  $-X^3-NR^jR^k$ ,  $-X^3-CO_2R^j$ ,  $-X^3-CONR^jR^k$ , -

$X^3-CONHSO_2R^j$  and  $SF_5$ ; wherein  $X^3$  is C<sub>1-6</sub> alkylene and is optionally further

substituted with OH,  $SO_2NH_2$ ,  $CONH_2$ ,  $C(O)NHOH$ ,  $PO_3H_2$ ,  $COO-C_{1-8}$ alkyl or

$CO_2H$ , wherein each  $R^j$  and  $R^k$  is independently selected from hydrogen C<sub>1-8</sub> alkyl

optionally substituted with 1 to 2 substituents selected from OH,  $SO_2NH_2$ ,  $CONH_2$ ,

$C(O)NHOH$ ,  $PO_3H_2$ ,  $COO-C_{1-8}$ alkyl or  $CO_2H$ , and C<sub>1-8</sub>haloalkyl optionally

substituted with 1 to 2 substituents selected from OH,  $SO_2NH_2$ ,  $CONH_2$ ,

$C(O)NHOH$ ,  $PO_3H_2$ ,  $COO-C_{1-8}$ alkyl or  $CO_2H$ , or when attached to the same nitrogen

atom  $R^j$  and  $R^k$  can be combined with the nitrogen atom to form a five or six-

membered ring having from 0 to 2 additional heteroatoms as ring members selected

from N, O or S, and optionally substituted with oxo; each  $R^l$  is independently selected

from the group consisting of -OH, C<sub>1-8</sub> alkyl, C<sub>2-8</sub> alkenyl, and C<sub>1-8</sub> haloalkyl each of

which may be optionally substituted with OH,  $SO_2NH_2$ ,  $CONH_2$ ,  $C(O)NHOH$ ,  $PO_3H_2$ ,

$COO-C_{1-8}$ alkyl or  $CO_2H$ ;

$R^g$  is selected from the group consisting of H, C<sub>1-8</sub>haloalkyl and C<sub>1-8</sub> alkyl;

$R^h$  is selected from -C<sub>1-8</sub>alkyl, C<sub>1-8</sub>haloalkyl, C<sub>1-8</sub>hydroxyalkyl, C<sub>1-8</sub>alkyl- $CO_2R^j$ , C<sub>1-8</sub>alkyl-

$CONR^jR^k$ , and C<sub>1-8</sub>alkyl- $CONHSO_2R^j$ , C<sub>1-8</sub>alkyl- $-SO_2NR^jR^k$ , C<sub>1-8</sub>alkyl- $-SO_3R^j$ , C<sub>1-8</sub>

alkyl-  $B(OH)_2$ , C<sub>1-8</sub>alkyl- $PO_3H_2$ , C<sub>1-8</sub>alkyl- $C(O)NHOH$ , C<sub>1-8</sub>alkyl- $-NR^{h1}R^{h2}$ , -

$C(O)R^j$ , C<sub>3-10</sub>cycloalkyl, C<sub>3-10</sub>cycloalkyl- $COOR^j$ , C<sub>3-10</sub>cycloalkyl- $OR^j$ , C<sub>4-8</sub>

heterocyclyl, C<sub>4-8</sub>heterocyclyl- $COOR^j$ , C<sub>4-8</sub>heterocyclyl- $OR^j$ , C<sub>1-8</sub>alkyl-C<sub>4-8</sub>

heterocyclyl,  $-C(=O)OC_{1-8}$ alkyl-C<sub>4-8</sub>heterocyclyl, C<sub>1-8</sub>alkyl-C<sub>3-10</sub>cycloalkyl, C<sub>5-10</sub>

heteroaryl, C<sub>1-8</sub>alkyl-C<sub>5-10</sub>heteroaryl, - C<sub>1-8</sub>alkyl-C<sub>6-10</sub>aryl, - C<sub>1-8</sub>alkyl- $(C=O)-C_{6-10}$

aryl, -CO<sub>2</sub>- C<sub>1-8</sub> alkyl-O<sub>2</sub>C-C<sub>1-8</sub> alkyl, - C<sub>1-8</sub> alkyl-NH(C=O)-C<sub>2-8</sub> alkenyl, - C<sub>1-8</sub> alkyl-NH(C=O)- C<sub>1-8</sub> alkyl, - C<sub>1-8</sub> alkyl- NH(C=O)-C<sub>2-8</sub> alkynyl, - C<sub>1-8</sub> alkyl -(C=O)-NH-C<sub>1-8</sub> alkyl-COOR<sup>j</sup>, and - C<sub>1-8</sub> alkyl-(C=O)- NH-C<sub>1-8</sub> alkyl-OR<sup>j</sup> optionally substituted with CO<sub>2</sub>H; or

R<sup>h</sup> combined with the N to which it is attached is a mono-, di- or tri-peptide comprising 1-3 natural amino acids and 0-2 non-natural amino acids, wherein

the non-natural aminoacids have an alpha carbon substituent selected from the group consisting of C<sub>2-4</sub> hydroxyalkyl, C<sub>1-3</sub> alkyl-guanidiny, and C<sub>1-4</sub> alkyl-heteroaryl, the alpha carbon of each natural or non-natural amino acids are optionally further substituted with a methyl group, and

the terminal moiety of the mono-, di-, or tri-peptide is selected from the group consisting of C(O)OH, C(O)O-C<sub>1-6</sub> alkyl, and PO<sub>3</sub>H<sub>2</sub>, wherein

R<sup>h1</sup> and R<sup>h2</sup> are each independently selected from the group consisting of H, C<sub>1-6</sub> alkyl, and C<sub>1-4</sub> hydroxyalkyl;

the C<sub>1-8</sub> alkyl portions of R<sup>h</sup> are optionally further substituted with from 1 to 3 substituents independently selected from OH, COOH, SO<sub>2</sub>NH<sub>2</sub>, CONH<sub>2</sub>, C(O)NHOH, COO-C<sub>1-8</sub> alkyl, PO<sub>3</sub>H<sub>2</sub> and C<sub>5-6</sub>heteroaryl optionally substituted with 1 to 2 C<sub>1-3</sub> alkyl substituents,

the C<sub>5-10</sub> heteroaryl and the C<sub>6-10</sub> aryl portions of R<sup>h</sup> are optionally substituted with 1 to 3 substituents independently selected from OH, B(OH)<sub>2</sub>, COOH, SO<sub>2</sub>NH<sub>2</sub>, CONH<sub>2</sub>, C(O)NHOH, PO<sub>3</sub>H<sub>2</sub>, COO-C<sub>1-8</sub>alkyl, C<sub>1-4</sub>alkyl, C<sub>1-4</sub>alkyl-OH, C<sub>1-4</sub>alkyl-SO<sub>2</sub>NH<sub>2</sub>, C<sub>1-4</sub>alkyl CONH<sub>2</sub>, C<sub>1-4</sub>alkyl-C(O)NHOH, C<sub>1-4</sub>alkyl- PO<sub>3</sub>H<sub>2</sub>, C<sub>1-4</sub>alkyl-COOH, and phenyl and the C<sub>4-8</sub> heterocyclyl and C<sub>3-10</sub> cycloalkyl portions of R<sup>h</sup> are optionally substituted with 1 to 4 R<sup>w</sup> substituents;

each R<sup>w</sup> substituent is independently selected from C<sub>1-4</sub> alkyl, C<sub>1-4</sub> alkyl-OH, C<sub>1-4</sub> alkyl-COOH, C<sub>1-4</sub> alkyl-SO<sub>2</sub>NH<sub>2</sub>, CM alkyl CONH<sub>2</sub>, CM alkyl-C(O)NHOH, C<sub>1-4</sub> alkyl- PO<sub>3</sub>H, OH, COO-C<sub>1-8</sub> alkyl, COOH, SO<sub>2</sub>NH<sub>2</sub>, CONH<sub>2</sub>, C(O)NHOH, PO<sub>3</sub>H<sub>2</sub> and oxo;

R<sup>4</sup> is selected from the group consisting of O-C<sub>1-8</sub> alkyl, O-C<sub>1-8</sub> haloalkyl, C<sub>6-10</sub> aryl, C<sub>5-10</sub> heteroaryl, -O-C<sub>1-4</sub> alkyl-C<sub>4-7</sub> heterocycloalkyl, -O-C<sub>1-4</sub> alkyl-C<sub>6-10</sub> aryl and -O-C<sub>1-4</sub> alkyl-C<sub>5-10</sub> heteroaryl, each of which is optionally substituted with 1 to 5 R<sup>4a</sup>;

each R<sup>4a</sup> is independently selected from the group consisting of halogen, -CN, -R<sup>m</sup>, -CO<sub>2</sub>R<sup>n</sup>,

-CONR<sup>n</sup>R<sup>p</sup>, -C(O)R<sup>n</sup>, -OC(O)NR<sup>n</sup>R<sup>p</sup>, -NR<sup>n</sup>C(O)R<sup>p</sup>, -NR<sup>n</sup>C(O)<sub>2</sub>R<sup>m</sup>, -NR<sup>n</sup>-C(O)NR<sup>n</sup>R<sup>p</sup>,  
 -NR<sup>n</sup>R<sup>p</sup>, -OR<sup>n</sup>, -O-X<sup>4</sup>-OR<sup>n</sup>, -O-X<sup>4</sup>-NR<sup>n</sup>R<sup>p</sup>, -OX<sup>4</sup>-CO<sub>2</sub>R<sup>n</sup>, -OX<sup>4</sup>-CONR<sup>n</sup>R<sup>p</sup>,  
 -X<sup>4</sup>-OR<sup>n</sup>, -X<sup>4</sup>-NR<sup>n</sup>R<sup>p</sup>, -X<sup>4</sup>-CO<sub>2</sub>R<sup>n</sup>, -X<sup>4</sup>-CONR<sup>n</sup>R<sup>p</sup>, -SF<sub>5</sub>, -S(O)<sub>2</sub>R<sup>n</sup>R<sup>p</sup>, -S(O)<sub>2</sub>NR<sup>n</sup>R<sup>p</sup>, C<sub>3-7</sub>  
 cycloalkyl and C<sub>4-7</sub> heterocycloalkyl, wherein the cycloalkyl and heterocycloalkyl rings  
 are optionally substituted with 1 to 5 R<sup>1</sup>, wherein each R<sup>1</sup> is independently selected from the  
 group consisting of C<sub>1-8</sub> alkyl, C<sub>1-8</sub>haloalkyl, -CO<sub>2</sub>R<sup>n</sup>, -CONR<sup>n</sup>R<sup>p</sup>, -C(O)R<sup>n</sup>,  
 -OC(O)NR<sup>n</sup>R<sup>p</sup>, -NR<sup>n</sup>C(O)R<sup>p</sup>, -NR<sup>n</sup>C(O)<sub>2</sub>R<sup>m</sup>, -NR<sup>n</sup>-C(O)NR<sup>n</sup>R<sup>p</sup>, -NR<sup>n</sup>R<sup>p</sup>, -OR<sup>n</sup>,  
 -OX<sup>4</sup>-OR<sup>n</sup>, -OX<sup>4</sup>-NR<sup>n</sup>R<sup>p</sup>, -OX<sup>4</sup>-CO<sub>2</sub>R<sup>n</sup>, -OX<sup>4</sup>-CONR<sup>n</sup>R<sup>p</sup>, -X<sup>4</sup>-OR<sup>n</sup>, -X<sup>4</sup>-NR<sup>n</sup>R<sup>p</sup>,  
 -X<sup>4</sup>-CO<sub>2</sub>R<sup>n</sup>, -X<sup>4</sup>-CONR<sup>n</sup>R<sup>p</sup>, -SF<sub>5</sub>, and -S(O)<sub>2</sub>NR<sup>n</sup>R<sup>p</sup>;

wherein each X<sup>4</sup> is a C<sub>1-6</sub> alkylene; each R<sup>n</sup> and R<sup>p</sup> is independently selected from hydrogen,  
 C<sub>1-8</sub> alkyl, and C<sub>1-8</sub> haloalkyl, or when attached to the same nitrogen atom can be  
 combined with the nitrogen atom to form a five or six-membered ring having from 0 to  
 2 additional heteroatoms as ring members selected from N, O or S, and optionally  
 substituted with oxo; each R<sub>m</sub> is independently selected from the group consisting of C<sub>1-8</sub>  
 alkyl, C<sub>2-8</sub> alkenyl, and C<sub>1-8</sub> haloalkyl; and optionally when two R substituents are on  
 adjacent atoms, they are combined to form a fused five or six-membered carbocyclic or  
 heterocyclic ring optionally substituted with oxo;

n is 0 or 1;

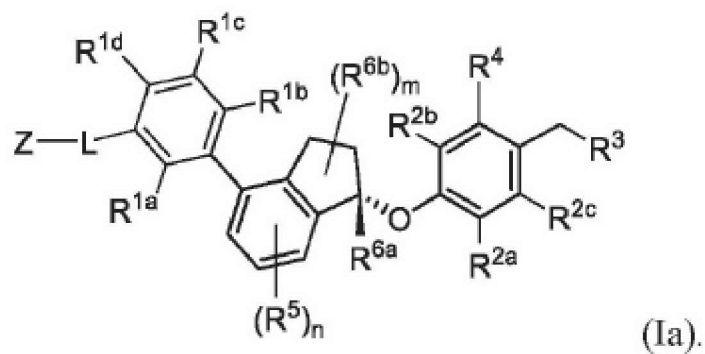
each R<sup>5</sup> is independently selected from the group consisting of halogen, C<sub>1-8</sub> alkyl, and  
 C<sub>1-8</sub> haloalkyl;

R<sup>6a</sup> is H;

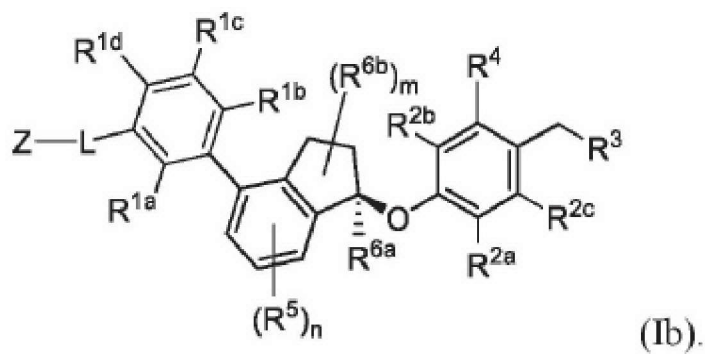
m is 0 or 1;

each R<sup>6b</sup> is F.

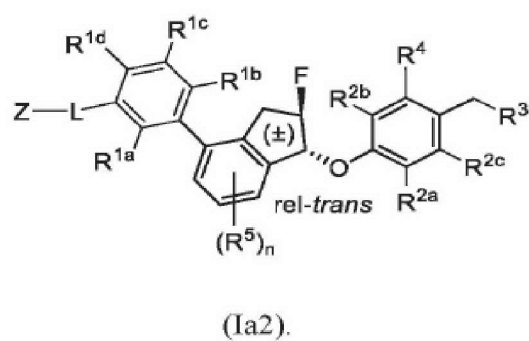
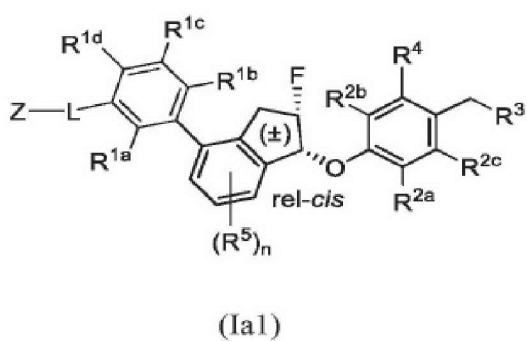
2. The compound as claimed in claim 1, or a pharmaceutically acceptable salt thereof  
 having the formula (Ia)



3. The compound as claimed in claim 1, or a pharmaceutically acceptable salt thereof having the formula (Ib)



4. The compound as claimed in claim 1, or a pharmaceutically acceptable salt thereof having formula (Ia1) or (Ia2):



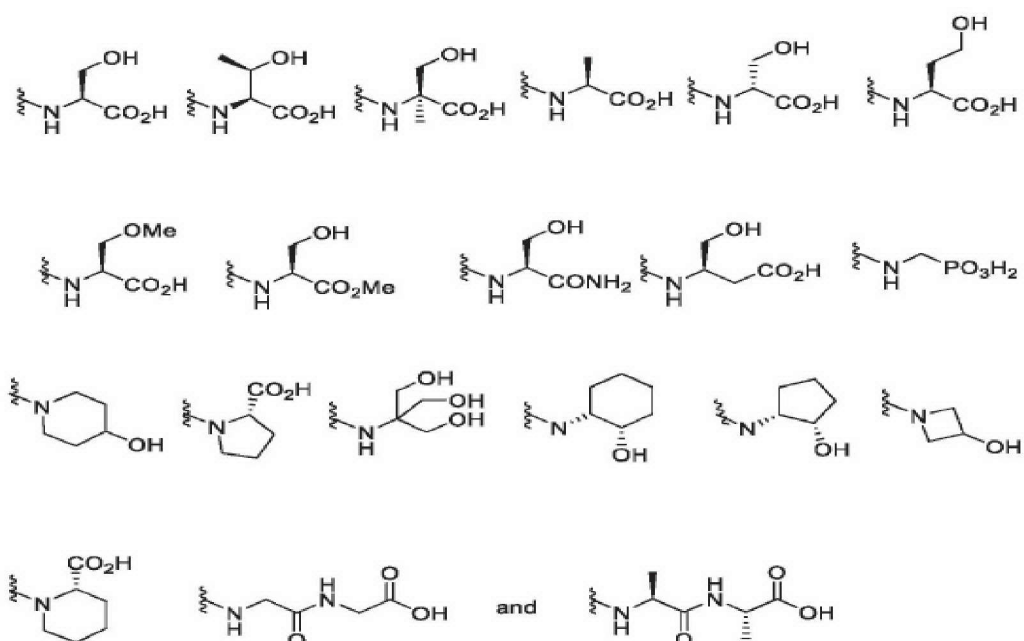
5. The compound as claimed in any one of claims 1 to 3, or a pharmaceutically acceptable salt thereof wherein  $R^3$  is  $-NR^gR^h$ .



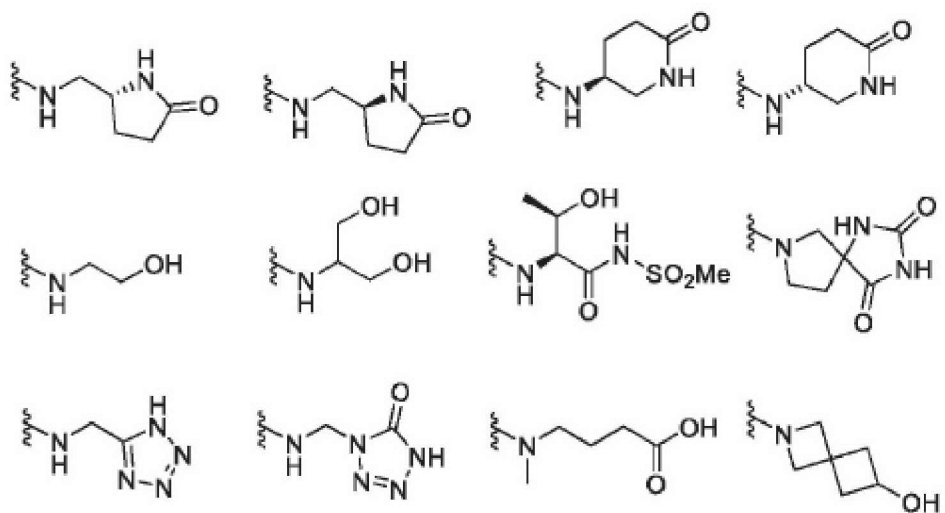
6. The compound as claimed in any one of claims 1 to 3, or a pharmaceutically acceptable salt thereof wherein  $R^3$  is  $C_{4-12}$  heterocyclyl, wherein the  $C_{4-12}$  heterocyclyl is optionally substituted with 1 to 6  $R^{3a}$ .

7. The compound as claimed in claim 6, wherein the  $C_{4-12}$  heterocyclyl is a  $C_{7-11}$  spiroheterocyclyl and is optionally substituted with 1 to 6  $R^{3a}$ .

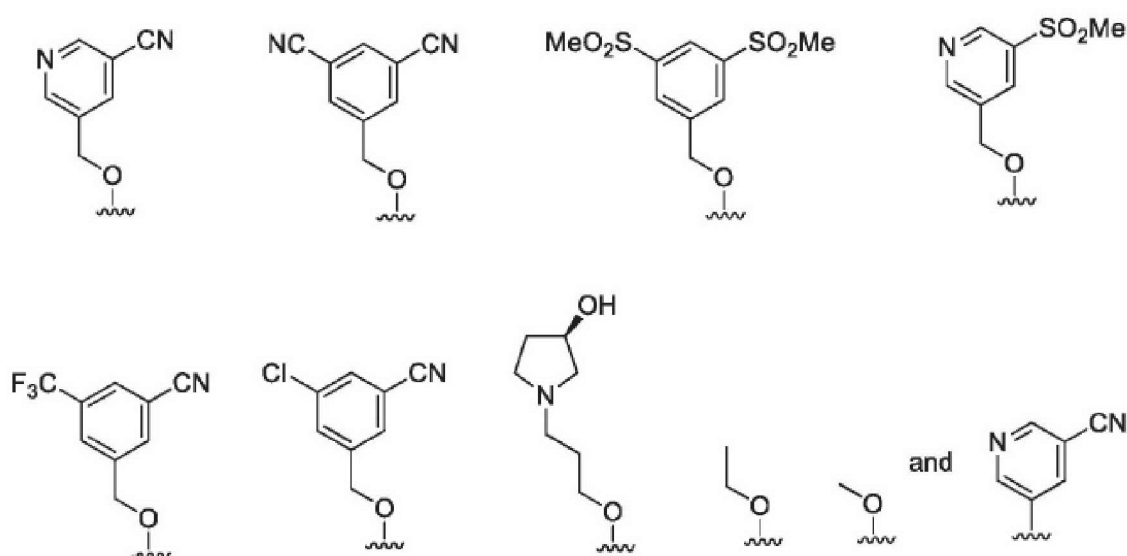
8. The compound as claimed in any one of claims 1 to 3, or a pharmaceutically acceptable salt thereof wherein  $R^3$  is selected from the group consisting of:



9. The compound as claimed in any one of claims 1 to 3, or a pharmaceutically acceptable salt thereof wherein  $R^3$  is selected from the group consisting of:

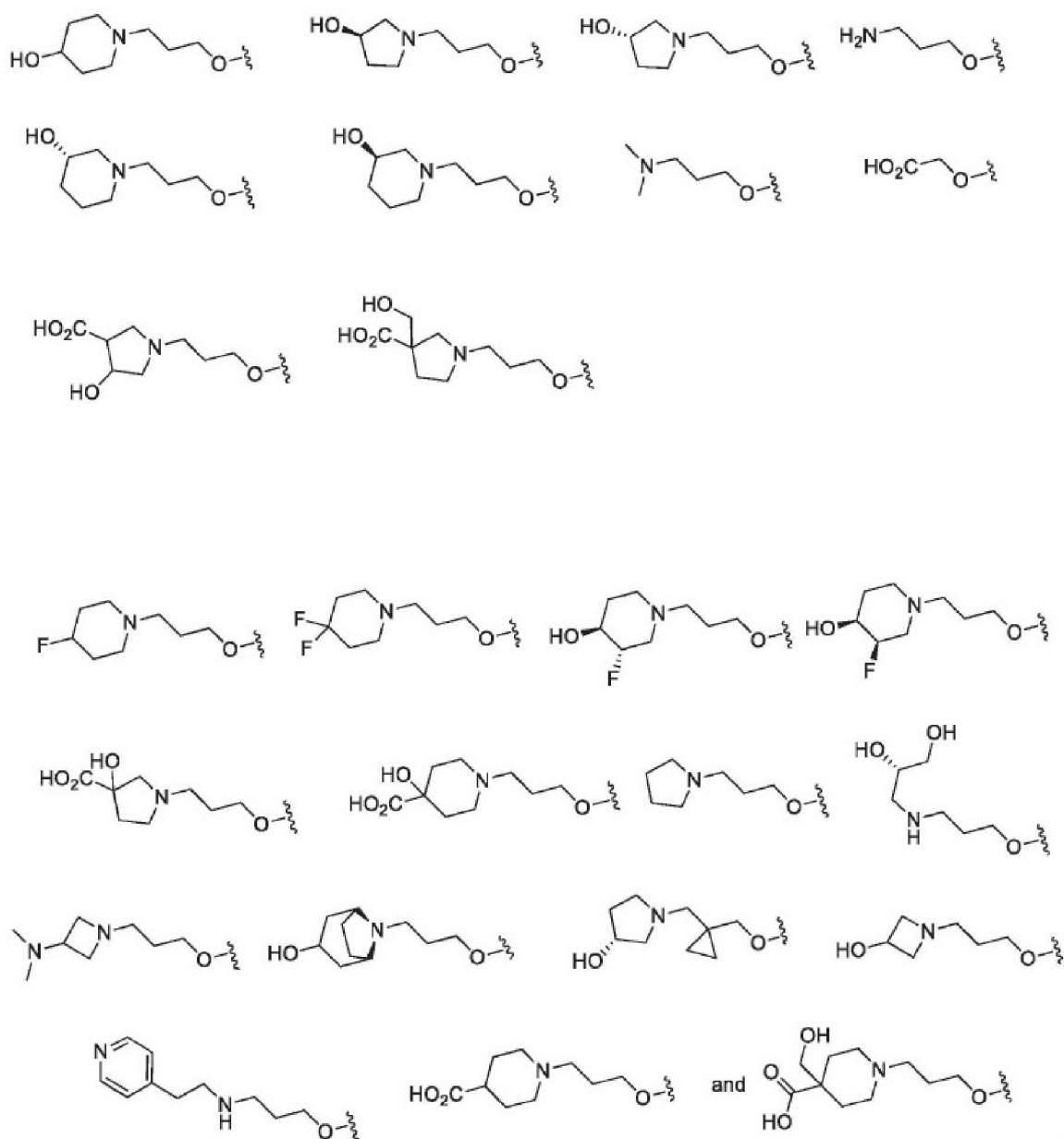


10. The compound as claimed in any one of claims 1 to 3, or a pharmaceutically acceptable salt thereof wherein  $R^4$  is selected from the group consisting of:



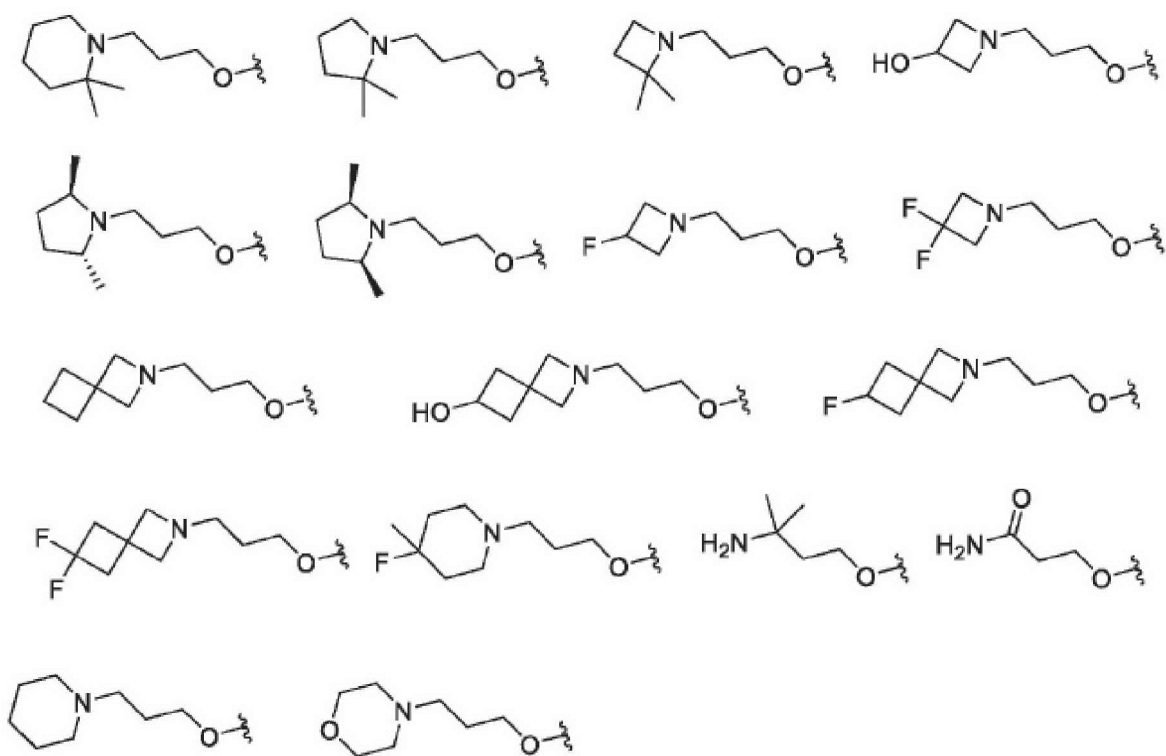
11. The compound as claimed in any one of claims 1 to 10, or a pharmaceutically acceptable salt thereof wherein  $n$  is 0.

12. The compound as claimed in any one of claims 1 to 11 or a pharmaceutically acceptable salt thereof, wherein the group Z-L- is selected from the group consisting of:

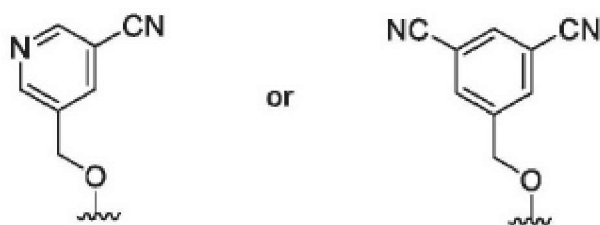


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13. The compound as claimed in any of claims 1 to 11 or pharmaceutically acceptable salt thereof, wherein the group Z-L- is selected from the group consist of:



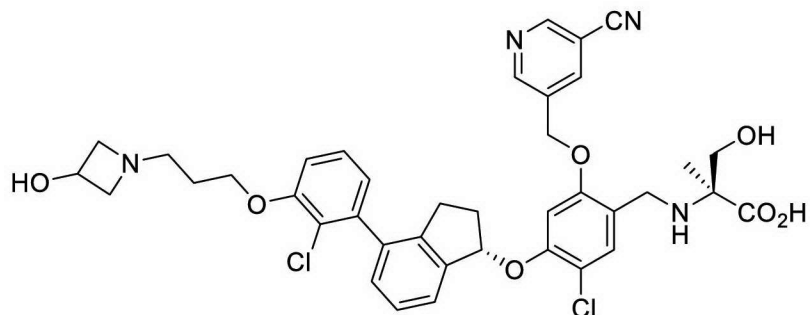
14. The compound as claimed in any one of claims 1 to 11 or a pharmaceutically acceptable salt thereof, wherein  $R^4$  is selected from the group consisting of:



15. The compound as claimed in any one of claims 1 to 3, or a pharmaceutically acceptable salt thereof, wherein  $R^{2b}$  and  $R^{2c}$  are both H and  $R^{2a}$  is Cl.

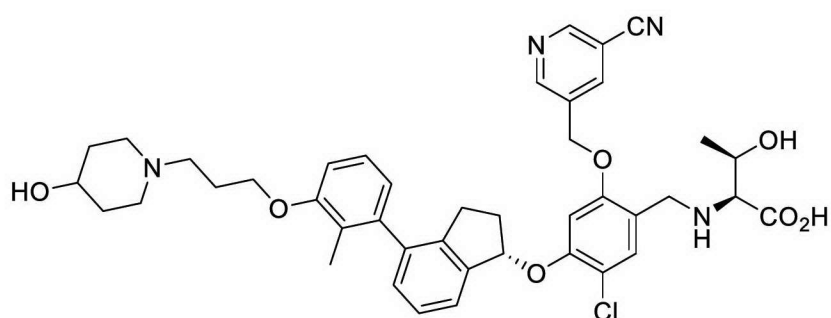
16. The compound as claimed in any one of claims 1 to 3, or a pharmaceutically acceptable salt thereof, wherein m is 0.

17. The compound of claim 1, having the formula



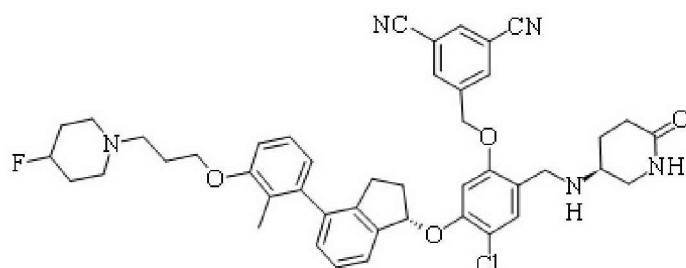
or a pharmaceutically acceptable salt thereof.

18. The compound of claim 1, having the formula



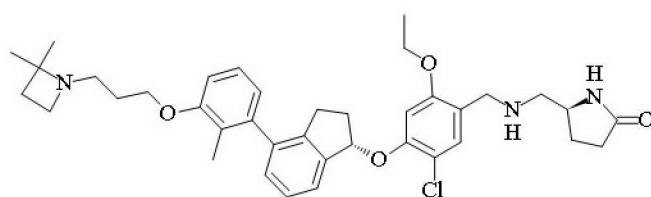
or a pharmaceutically acceptable salt thereof.

19. The compound of claim 1, having the formula



or a pharmaceutically acceptable salt thereof.

20. The compound of claim 1, having the formula



or a pharmaceutically acceptable salt thereof.

21. A pharmaceutical composition comprising a compound as claimed in any one of claims 1 to 20, or a pharmaceutically acceptable salt thereof, and a pharmaceutically acceptable excipient.

22. A method of modulating an immune response mediated by the PD-1 signaling pathway in a subject, comprising administering to the subject a therapeutically effective amount of a compound of any one of claims 1 to 20, or a pharmaceutically acceptable salt thereof or a composition of claim 21.

23. A method of enhancing, stimulating, modulating and/or increasing the immune response in a subject in need thereof, comprising administering to the subject a therapeutically effective amount of a compound of any one of claims 1 to 20, or a pharmaceutically acceptable salt thereof or a composition of claim 21.

24. A method of inhibiting growth, proliferation, or metastasis of cancer cells in a subject in need thereof, comprising administering to the subject a therapeutically effective amount of a compound of any one of claims 1 to 20, or a pharmaceutically acceptable salt thereof or a composition of claim 21.

25. A method of treating a subject suffering from or susceptible to a disease or disorder mediated by the PD-1 signaling pathway, comprising administering to the subject a therapeutically effective amount of a compound of any one of claims 1 to 20, or a pharmaceutically acceptable salt thereof or a composition of claim 21.

26. The method of any one of claims 22 to 25, wherein the subject suffers from a disease or disorder selected from the group consisting of an infectious disease, a bacterial infectious disease, a viral infectious disease, a fungal infectious disease, a solid tumor, a hematological malignancy, an immune disorder, an inflammatory disease, and cancer.

27. The method of claim 25, wherein the disease or disorder is selected from the group consisting of melanoma, glioblastoma, esophagus tumor, nasopharyngeal carcinoma, uveal melanoma, lymphoma, lymphocytic lymphoma, primary CNS lymphoma, T-cell lymphoma, diffuse large B-cell lymphoma, primary mediastinal large B-cell lymphoma, prostate cancer, castration-resistant prostate cancer, chronic myelocytic leukemia, Kaposi's

sarcoma fibrosarcoma, liposarcoma, chondrosarcoma, osteogenic sarcoma, angiosarcoma, lymphangiosarcoma, synovioma, , meningioma, leiomyosarcoma, rhabdomyosarcoma, sarcoma of soft tissue, sarcoma, sepsis, biliary tumor, basal cell carcinoma, thymus neoplasm, cancer of the thyroid gland, cancer of the parathyroid gland, uterine cancer, cancer of the adrenal gland, liver infection, Merkel cell carcinoma, nerve tumor, follicle center lymphoma, colon cancer, Hodgkin's disease, non-Hodgkin's lymphoma, leukemia, chronic or acute leukemias including acute myeloid leukemia, chronic myeloid leukemia, acute lymphoblastic leukemia, chronic lymphocytic leukemia, multiple myeloma, ovary tumor, myelodysplastic syndrome, cutaneous or intraocular malignant melanoma, renal cell carcinoma, small-cell lung cancer, lung cancer, mesothelioma, breast cancer, squamous non-small cell lung cancer (SCLC), non-squamous NSCLC, colorectal cancer, ovarian cancer, gastric cancer, hepatocellular carcinoma, pancreatic carcinoma, pancreatic cancer, Pancreatic ductal adenocarcinoma, squamous cell carcinoma of the head and neck, cancer of the head or neck, gastrointestinal tract, stomach cancer, HIV, Hepatitis A, Hepatitis B, Hepatitis C, hepatitis D, herpes viruses, papillomaviruses, influenza, bone cancer, skin cancer, rectal cancer, cancer of the anal region, testicular cancer, carcinoma of the fallopian tubes, carcinoma of the endometrium, carcinoma of the cervix, carcinoma of the vagina, carcinoma of the vulva, cancer of the esophagus, cancer of the small intestine, cancer of the endocrine system, cancer of the urethra, cancer of the penis, cancer of the bladder, cancer of the kidney, cancer of the ureter, carcinoma of the renal pelvis, neoplasm of the central nervous system (CNS), tumor angiogenesis, spinal axis tumor, brain stem glioma, pituitary adenoma, epidermoid cancer, abestosis, carcinoma, adenocarcinoma, papillary carcinoma, cystadenocarcinoma, bronchogenic carcinoma, renal cell carcinoma, transitional cell carcinoma, choriocarcinoma, seminoma, embryonal carcinoma, wilm's tumor, pleomorphic adenoma, liver cell papilloma, renal tubular adenoma, cystadenoma, papilloma, adenoma, leiomyoma, rhabdomyoma, hemangioma, lymphangioma, osteoma, chondroma, lipoma and fibroma.

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