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(71) Applicant: **BRISTOL-MYERS SQUIBB COMPANY** [US/US]; Route 206 and Province Line Road, Princeton, New Jersey 08543 (US).

(72) Inventors: **WANG, Tao**; 22 Inwood Lane, Farmington, Connecticut 06032 (US). **ZHANG, Zhongxing**; c/o Bristol-Myers Squibb Company, 100 Binney Street, Cambridge, Massachusetts 02142 (US). **YIN, Zhiwei**; 24 Forest Lane, Glastonbury, Connecticut 06033 (US).

(74) Agent: **SUN, Jing G.** et al.; Bristol-Myers Squibb Company, Route 206 and Province Line Road, Princeton, New Jersey 08543 (US).

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(54) Title: LACTONE AND LACTAM CONTAINING COMPOUNDS USEFUL AS IMMUNOMODULATORS

(57) Abstract: The present disclosure generally relates to lactone and lactam containing compounds useful as immunomodulators. Provided herein are compounds, compositions comprising such compounds, and methods of their use. The disclosure further pertains to pharmaceutical compositions comprising at least one compound according to the disclosure that are useful for the treatment of various diseases, including cancer and infectious diseases.

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LACTONE AND LACTAM CONTAINING COMPOUNDS USEFUL AS IMMUNOMODULATORS

The present disclosure generally relates to lactone and lactam containing compounds useful as inhibitors of the PD-1/PD-L1 protein/protein and CD80/PD-L1 protein/protein interactions. Provided herein are compounds, compositions comprising such compounds, and methods of their use. The disclosure further pertains to pharmaceutical compositions comprising at least one compound according to the disclosure that are useful for the treatment of various diseases, including cancer and infectious diseases.

Programmed death-1 (CD279) is a receptor on T cells that has been shown to suppress activating signals from the T cell receptor when bound by either of its ligands, Programmed death-ligand 1 (PD-L1, CD274, B7-H1) or PD-L2 (CD273, B7-DC) (Sharpe *et al.*, *Nat. Imm.* 2007). When PD-1 expressing T cells contact cells expressing its ligands, functional activities in response to antigenic stimuli, including proliferation, cytokine secretion, and cytolytic activity are reduced. PD-1/PD-Ligand interactions down regulate immune responses during resolution of an infection or tumor, or during the development of self tolerance (Keir Me, Butte MJ, Freeman GJ, *et al. Annu. Rev. Immunol.* 2008; 26: Epub). Chronic antigen stimulation, such as that which occurs during tumor disease or chronic infections, results in T cells that express elevated levels of PD-1 and are dysfunctional with respect to activity towards the chronic antigen (reviewed in Kim and Ahmed, Curr Opin Imm, 2010). This is termed “T cell exhaustion”. B cells also display PD-1/PD-ligand suppression and “exhaustion”.

PD-L1 has also been shown to interact with CD80 (Butte MJ *et al.*, *Immunity* 27:111–122 (2007)). The interaction of PD-L1/CD80 on expressing immune cells has been shown to be an inhibitory one. Blockade of this interaction has been shown to abrogate this inhibitory interaction (Paterson AM, *et al.*, *J Immunol.*, 187:1097–1105 (2011); Yang J, *et al. J Immunol.* Aug 1;187(3):1113-9 (2011)).

Blockade of the PD-1/PD-L1 interaction using antibodies to PD-L1 has been shown to restore and augment T cell activation in many systems. Patients with advanced cancer benefit from therapy with a monoclonal antibody to PD-L1 (Brahmer *et al.*, *New Engl J Med* 2012). Preclinical animal models of tumors have shown that blockade of the

PD-1/PD-L1 pathway by monoclonal antibodies can enhance the immune response and result in the immune response to a number of histologically distinct tumors (Dong H, Chen L. *J Mol Med.* 2003; 81(5):281-287; Dong H, Strome SE, Salamoa DR, *et al. Nat Med.* 2002; 8(8):793-800).

Interference with the PD-1/PD-L1 interaction has also shown enhanced T cell activity in chronic infection systems. Chronic lymphocytic chorio meningitis virus infection of mice also exhibits improved virus clearance and restored immunity with blockade of PD-L1 (Barber DL, Wherry EJ, Masopust D, *et al. Nature* 2006; 439(7077):682-687). Humanized mice infected with HIV-1 show enhanced protection against viremia and reduced viral depletion of CD4+ T cells (Palmer *et al.*, *J. Immunol* 2013). Blockade of PD-1/PD-L1 through monoclonal antibodies to PD-L1 can restore *in vitro* antigen-specific functionality to T cells from HIV patients (Day, *Nature* 2006; Petrovas, *J. Exp. Med.* 2006; Trautman, *Nature Med.* 2006; D'Souza, *J.Immunol.* 2007; Zhang, *Blood* 2007; Kaufmann, *Nature Imm.* 2007; Kasu, *J. Immunol.* 2010; Porichis, *Blood* 2011), HCV patients [Golden-Mason, *J. Virol.* 2007; Jeung, J. Leuk. *Biol.* 2007; Urbani, *J. Hepatol.* 2008; Nakamoto, *PLoS Path.* 2009; Nakamoto, *Gastroenterology* 2008] or HBV patients (Boni, „*J. Virol.* 2007; Fisicaro, *Gastro.* 2010; Fisicaro *et al.*, *Gastroenterology,* 2012; Boni *et al.*, *Gastro.,* 2012; Penna *et al., J Hep,* 2012; Raziorrough, *Hepatology* 2009; Liang, *World J Gastro.* 2010; Zhang, *Gastro.* 2008).

Blockade of the PD-L1/CD80 interaction has also been shown to stimulate immunity (Yang J., et al., *J Immunol.* Aug 1;187(3):1113-9 (2011)). The immune stimulation resulting from blockade of the PD-L1/CD80 interaction has been shown to be enhanced through combination with blockade of further PD-1/PD-L1 or PD-1/PD-L2 interactions.

Alterations in immune cell phenotypes are hypothesized to be an important factor in septic shock (Hotchkiss, et al., *Nat Rev Immunol* (2013)). These include increased levels of PD-1 and PD-L1 and T ceoll apoptosis (Guignant, et al, *Crit. Care* (2011)). Antibodies directed to PD-L1 can reduce the level of Immune cell apoptosis (Zhang et al, *Crit. Care* (2011)). Furthermore, mice lacking PD-1 expression are more resistant to septic shock symptoms than wildtype mice (Yang J., et al.. *J Immunol.* Aug 1;187(3):1113-9 (2011)). Studies have revealed that blockade of the interactions of PD-

L1 using antibodies can suppress inappropriate immune responses and ameliorate disease symptoms.

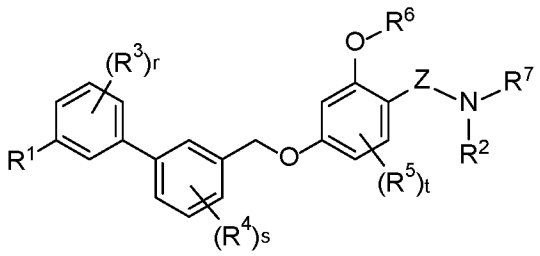
In addition to enhancing immunologic responses to chronic antigens, blockade of the PD-1/PD-L1 pathway has also been shown to enhance responses to vaccination, including therapeutic vaccination in the context of chronic infection (S. J. Ha, S. N. Mueller, E. J. Wherry *et al.*, *The Journal of Experimental Medicine,* vol. 205, no. 3, pp. 543–555, 2008.; A. C. Finnefrock, A. Tang, F. Li *et al., The Journal of Immunology*, vol. 182, no. 2, pp.980–987, 2009; M. -Y. Song, S. -H. Park, H. J. Nam, D. -H. Choi, and Y.-C. Sung, *The Journal of Immunotherapy,* vol. 34, no. 3, pp. 297–306, 2011).

The PD-1 pathway is a key inhibitory molecule in T cell exhaustion that arises from chronic antigen stimulation during chronic infections and tumor disease. Blockade of the PD-1/PD-L1 interaction through targeting the PD-L1 protein has been shown to restore antigen-specific T cell immune functions *in vitro* and *in vivo*, including enhanced responses to vaccination in the setting of tumor or chronic infection.

Accordingly, agents that block the interaction of PD-L1 with either PD-1 or CD80 are desired.

Applicants found potent compounds that have activity as inhibitors of the interaction of PD-L1 with PD-1 and CD80, and thus may be useful for therapeutic administration to enhance immunity in cancer or infections, including therapeutic vaccine. These compounds are provided to be useful as pharmaceuticals with desirable stability, bioavailability, therapeutic index, and toxicity values that are important to their drugability.

In a first aspect, the present disclosure provides a compound of Formula (I):



(I)

or a pharmaceutically acceptable salt thereof, wherein:

R^1 is independently $-(O)_m-(CH_2)_n-R^{1a}$ or $-(CH_2)_n-(O)_m-R^{1b}$;

R^{1a} is independently a 5- to 6-membered heterocycle with one to two heteroatoms selected from O, N, S, and NR^a; wherein said heterocycle is substituted with 0 to 3 R^b;

R^{1b} is phenyl or a 5- to 6-membered heteroaryl with one to four heteroatoms selected from O, N, S, and NR^a; wherein said phenyl and heteroaryl are substituted with 0 to 3 R^{1c};

R^{1c} is independently halogen, CN, OH, SH, NH_2, C_1-C_4 haloalkyl, C_1-C_4 alkoxy, C_1-C_4 haloalkoxy, C_1-C_4 alkyl substituted with 0 to 1 OH, or C_3-C_6 cycloalkyl, $-(O)_m-(CH_2)_n-R^{1d}$, or $-(CH_2)_n-NR^7-R^{2a}$;

R^{1d} is phenyl or a 5- to 6-membered heteroaryl with one to four heteroatoms selected from O, N, S, and NR^a; wherein said phenyl and heteroaryl are substituted with 0 to 3 R^d;

Z is a bond or a C_1-C_2 alkylene;

R^2 is independently a 4- to 8-membered lactone or lactam substituted with 0 to 4 R^c;

R^3, R^4 and R^5 are, at each occurrence, independently halogen, CN, OH, SH, NH_2, C_1-C_4 alkyl, C_1-C_4 haloalkyl, C_1-C_4 alkoxy, C_1-C_4 haloalkoxy, or C_3-C_6 cycloalkyl;

R^6 is independently hydrogen, C_1-C_4 alkyl, or $-(CH_2)_n-R^{6a}$;

R^{6a} is independently phenyl or a 5- to 6-membered heteroaryl with one to four heteroatoms selected from O, N, S, and NR^a; wherein said phenyl and heteroaryl are substituted with 0 to 3 R^{6b};

R^{6b} is independently halogen, CN, OH, C_1-C_4 alkyl, C_1-C_4 haloalkyl, C_1-C_4 alkoxy, or C_1-C_4 haloalkoxy;

R^7 is independently hydrogen, C_1-C_4 alkyl, $-C(O)C_1$-C_4 alkyl, $-(CH_2)_n-C_3$-C_6 cycloalkyl, or $-(CH_2)_n$-phenyl;

alternatively, R^6 and R^7 can be joined to form W; and

W is a 1 to 4 membered linker with elements independently selected from carbon, oxygen, and nitrogen; wherein said linker is substituted with 0 to 2 R^e;

R^a is independently halogen, C_1-C_4 alkyl, $-(CH_2)_n-C_3$-C_6 cycloalkyl, or $-(CH_2)_n$-phenyl;

R^b and R^c are, at each occurrence, independently oxo, halogen, CN, OH, C_1-C_4 alkyl, or C_1-C_4 alkoxy;

R^d is, at each occurrence, independently halogen, CN, OH, C_1-C_4 alkyl, or

C_1-C_4 alkoxy;

R^e is independently oxo, =CH_2, halogen, CN, OH, C_1-C_4 alkyl, or C_1-C_4 alkoxy;

m is, at each occurrence, independently 0 or 1;

n is, at each occurrence, independently 0, 1, or 2;

r, s, and t are each independently 0, 1, or 2.

In a second aspect, within the scope of the first aspect, wherein:

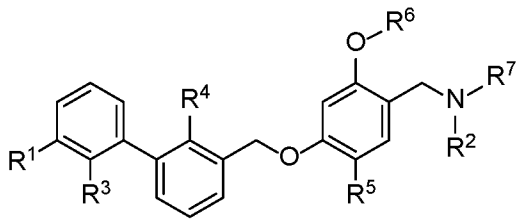
R^2 is independently a 5- to 6-membered lactone or lactam substituted with 0 to 4 R^a;

R^a is independently oxo, halogen, OH, or C_1-C_3 alkyl;

W is a 2 to 3 membered linker with elements independently selected from carbon, oxygen, and nitrogen; wherein said linker is substituted with 0 to 2 R^e; and

R^e is independently oxo, =CH_2, OH, or C_1-C_4 alkyl.

In a third aspect, the present disclosure provides a compound of Formula (II):



(II)

or a pharmaceutically acceptable salt thereof, wherein:

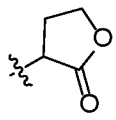
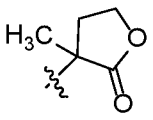
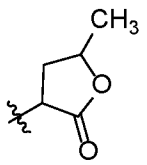
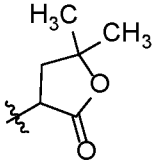
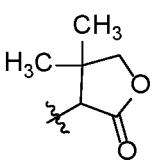
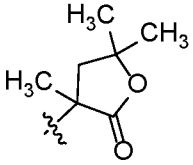
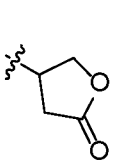
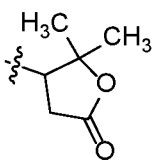
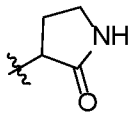
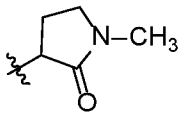
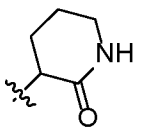
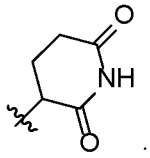
R^1 is independently -O-CH_2-R^{1a} or -CH_2-O-R^{1b};

R^{1a} is N-(C_1-C_3 alkyl)-piperidinyl;

R^{1b} is phenyl substituted with 1 to 3 R^{1c};

R^{1c} is independently halogen, -CH_2OH, -O-CH_2-R^{1d}, or -CH_2-NR^7-R^{2a};

R^{1d} is cyano-substituted pyridyl;

R^2 and R^{2a} are, at each occurrence, independently  ,  ,  ,  ,  ,  ,  ,  ,  ,  ,  , or  ;

R^3 is independently hydrogen, C_1-C_3 alkyl or halogen;

R^4 is independently hydrogen, C_1-C_3 alkyl or halogen;

R^5 is independently hydrogen, C_1-C_3 alkyl or halogen;

R^6 is independently hydrogen, C_1-C_3 alkyl, or -CH_2-(cyano-substituted pyridyl); and

R^7 is independently hydrogen, C_1-C_3 alkyl, -$C(O)C_1$-C_3 alkyl or -CH_2-cyclopropyl.

In a fourth aspect, within the scope of the third aspect, wherein:

R^1 is -O-CH_2-R^{1a};

R^{1a} is N-(C_1-C_3 alkyl)-piperidinyl;

R^6 is -CH_2-(cyano-substituted pyridyl); and

R^7 is hydrogen.

In a fifth aspect, within the scope of the third aspect, wherein:

R^1 is -CH_2-O-R^{1b};

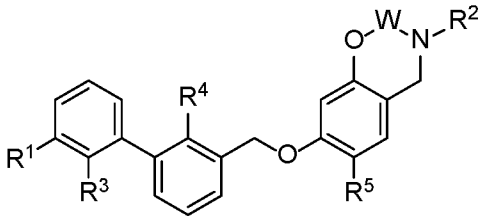
R^{1b} is phenyl substituted with 1 to 3 R^{1c};

R^{1c} is independently halogen, -O-CH_2-R^{1d}, or -CH_2-NR^7-R^{2a};

R^{1d} is cyano-substituted pyridyl; and

R^7 is hydrogen.

In a sixth aspect, the present disclosure provides a compound of Formula (III):



(III)

or a pharmaceutically acceptable salt thereof, wherein:

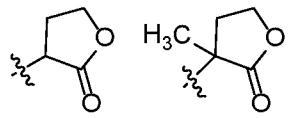
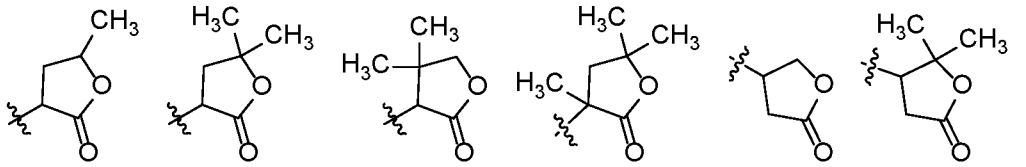
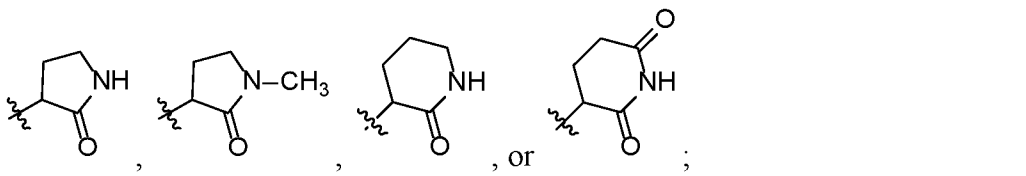
R^1 is independently -O-CH_2-R^{1a} or -CH_2-O-R^{1b};

R^{1a} is N-(C_1-C_3 alkyl)-piperidinyl;

R^{1b} is phenyl substituted with 1 to 3 R^{1c};

R^{1c} is independently halogen, -O-CH_2-R^{1d}, or -CH_2-NR^7-R^{2a};

R^{1d} is cyano-substituted pyridyl;

R^2 and R^{2a} are, at each occurrence, independently  ,  ,  , or ;

R^3 is independently hydrogen, C_1-C_3 alkyl or halogen;

R^4 is independently hydrogen, C_1-C_3 alkyl or halogen;

R^5 is independently hydrogen, C_1-C_3 alkyl or halogen; and

W is independently -$CH_2C(O)$-, -$CH_2C(=CH_2)CH_2$-, or -$CH_2C(OH)CH_2$-.

In another aspect, there is provided a compound selected from the exemplified Examples, or a pharmaceutically acceptable salt thereof.

In another aspect, there is provided a compound selected from any subset list of compounds within the scope of any of the above aspects.

The present disclosure also provides a pharmaceutical composition comprising a compound of the present invention, or a pharmaceutically acceptable salt thereof, and a pharmaceutically acceptable carrier.

In another aspect, the present disclosure provides a compound of the present invention, or a pharmaceutically acceptable salt thereof, or a pharmaceutical composition thereof, for use as a medicament.

In another aspect, the present disclosure provides a compound of the present invention, or a pharmaceutically acceptable salt thereof, or a pharmaceutical composition thereof, for use in the manufacture of a medicament for treatment of cancer in a subject in need thereof.

In another aspect, the present disclosure provides a compound of the present invention, or a pharmaceutically acceptable salt thereof, for use in enhancing, stimulating, modulating and/or increasing an immune response in a subject in need thereof, comprising administering to the subject a therapeutically effective amount of said compound or a pharmaceutically acceptable salt thereof.

In another aspect, the present disclosure provides a compound of the present invention, or a pharmaceutically acceptable salt thereof, for use in inhibiting growth, proliferation, or metastasis of cancer cells in a subject in need thereof, comprising administering to the subject a therapeutically effective amount of said compound or a pharmaceutically acceptable salt thereof.

In another aspect, the present disclosure provides a method of enhancing, stimulating, modulating and/or increasing the immune response in a subject in need thereof, said method comprising administering to the subject a therapeutically effective amount of a compound of the present invention, or a pharmaceutically acceptable salt thereof. In a first embodiment of the third aspect, the method further comprises administering an additional agent prior to, after, or simultaneously with the compound of the present invention, or the pharmaceutically acceptable salt thereof. In a second embodiment, the additional agent is an antimicrobial agent, an antiviral agent, a cytotoxic agent, a gene expression modulatory agent, and/or an immune response modifier.

In another aspect, the present disclosure provides a method of inhibiting growth, proliferation, or metastasis of cancer cells in a subject in need thereof, said method comprising administering to the subject a therapeutically effective amount of a compound of the present invention, or a pharmaceutically acceptable salt. In a first embodiment of the fourth aspect, the cancer is selected from melanoma, renal cell carcinoma, squamous non-small cell lung cancer (NSCLC), non-squamous NSCLC, colorectal cancer,

castration-resistant prostate cancer, ovarian cancer, gastric cancer, hepatocellular carcinoma, pancreatic carcinoma, squamous cell carcinoma of the head and neck, carcinomas of the esophagus, gastrointestinal tract and breast, and a hematological malignancy.

In another aspect, the present disclosure provides a method of treating an infectious disease in a subject in need thereof, the method comprising administering to the subject a therapeutically effective amount of a compound of the present invention, or a pharmaceutically acceptable salt thereof. In a first embodiment of the fifth aspect, the infectious disease is caused by a virus. In a second embodiment of the fifth aspect, the virus is selected from HIV, Hepatitis A, Hepatitis B, Hepatitis C, Hepatitis D, herpes viruses, papillomaviruses, and influenza.

In another aspect, the present disclosure provides a method of treating septic shock in a subject in need thereof, the method comprising administering to the subject a therapeutically effective amount of a compound of the present invention, or a pharmaceutically acceptable salt thereof.

Unless specifically stated otherwise herein, references made in the singular may also include the plural. For example, “a” and “an” may refer to either one, or one or more.

As used herein, the phase “compound(s) or pharmaceutically acceptable salts thereof” refers to at least one compound, at least one salt of the compounds, or a combination thereof. For example, compounds of the present invention or pharmaceutically acceptable salts thereof includes a compound of the present invention; two compounds of the present invention; a salt of a compound of the present invention; a compound of the present invention and one or more salts of the compound of the present invention; and two or more salts of a compound of the present invention.

Unless otherwise indicated, any atom with unsatisfied valences is assumed to have hydrogen atoms sufficient to satisfy the valences.

Throughout the specification, groups and substituents thereof may be chosen by one skilled in the field to provide stable moieties and compounds.

Listed below are definitions of various terms used to describe the present disclosure. These definitions apply to the terms as they are used throughout the specification (unless they are otherwise limited in specific instances) either individually

or as part of a larger group. The definitions set forth herein take precedence over definitions set forth in any patent, patent application, and/or patent application publication incorporated herein by reference.

The term "C_1-C_3 alkyl" as used herein, refers to a group derived from a straight or branched chain saturated hydrocarbon containing from one to three carbon atoms.

The term "C_1-C_6 alkyl" as used herein, refers to a group derived from a straight or branched chain saturated hydrocarbon containing from one to six carbon atoms.

The term "amido" as used herein, refers to $-C(O)NH_2$.

The term "aminocarbonyl" as used herein, refers to $-C(O)NH_2$.

The term "carbonyl" as used herein, refers to –C(O)-.

The term "carboxy" as used herein, refers to $-CO_2H$.

The term "cyano" as used herein, refers to –CN.

The term "cycloalkyl," as used herein, refers to a group derived from a non-aromatic monocyclic or polycyclic hydrocarbon molecule by removal of one hydrogen atom from a saturated ring carbon atom. Representative examples of cycloalkyl groups include, but are not limited to, cyclopropyl, cyclopentyl, and cyclohexyl. When numbers appear in a subscript after the symbol "C", the subscript defines with more specificity the number of carbon atoms that a particular cycloalkyl group may contain. For example, "C_{3-6} cycloalkyl" denotes cycloalkyl groups with three to six carbon atoms.

The term "(C_3-C_6 cycloalkyl)C_1-C_3 alkyl" as used herein, refers to a C_1-C_3 alkyl group substituted with a C_3-C_6 cycloalkyl group.

The terms "halo" and "halogen" as used herein, refer to F, Cl, Br, or I.

The term "C_1-C_4 haloalkoxy" as used herein, refers to a haloC_1-C_4alkyl group attached to the parent molecular moiety through an oxygen atom.

The term "C_1-C_3 haloalkyl" as used herein, refers to a C_1-C_3 alkyl group substituted with one, two, or three halogen atoms.

The term "hydroxyalkyl" includes both branched and straight-chain saturated alkyl groups substituted with one or more hydroxyl groups. For example, "hydroxyalkyl" includes $-CH_2OH$, $-CH_2CH_2OH$, and C_{1-4} hydroxyalkyl.

The term "nitro" as used herein, refers to $-NO_2$.

The term "oxo" as used herein, refers to =O.

The term "heteroatom" refers to oxygen (O), sulfur (S), and nitrogen (N).

The terms “heterocyclo”, “heterocyclic”, or “heterocyclyl” may be used interchangeably and refer to cyclic groups having at least one saturated or partially saturated non-aromatic ring and wherein one or more of the rings have at least one heteroatom (O, S or N), said heteroatom containing ring preferably having 1 to 3 heteroatoms independently selected from O, S, and/or N. The ring of such a group containing a heteroatom can contain one or two oxygen or sulfur atoms and/or from one to four nitrogen atoms provided that the total number of heteroatoms in each ring is four or less, and further provided that the ring contains at least one carbon atom. The nitrogen and sulfur atoms may optionally be oxidized and the nitrogen atoms may optionally be quaternized. The heterocyclo group may be attached at any available nitrogen or carbon atom. The heterocyclo ring may be unsubstituted or may contain one or more substituents as valence allows.

Exemplary monocyclic heterocyclyl groups include pyrrolidinyl, imidazolinyl, oxazolidinyl, isoxazolinyl, thiazolidinyl, isothiazolidinyl, tetrahydrofuranyl, piperidinyl, piperazinyl, 2-oxopiperazinyl, 2-oxopiperidinyl, 2-oxopyrrolodinyl, 2-oxoazepinyl, azepinyl, 4-piperidonyl, tetrahydropyranyl, morpholinyl, thiamorpholinyl, thiamorpholinyl sulfoxide, thiamorpholinyl sulfone, 1,3-dioxolane, tetrahydro-1,1-dioxothienyl, dihydroisoindolyl, and tetrahydroquinolinyl.

The term heterocyclyl also encompasses heteroaryl compounds.

Exemplary monocyclic heteroaryl groups include pyrrolyl, pyrazolyl, pyrazolinyl, imidazolyl, oxazolyl, isoxazolyl, thiazolyl, thiadiazolyl, isothiazolyl, furanyl, thiophenyl, oxadiazolyl, pyridinyl, pyrazinyl, pyrimidinyl, pyridazinyl, and triazinyl.

Exemplary bicyclic heteroaryl groups include indolyl, benzothiazolyl, benzodioxolyl, benzoxazolyl, benzothienyl, quinolinyl, tetrahydroisoquinolinyl, isoquinolinyl, benzimidazolyl, benzopyranyl, indolizinyl, benzofuranyl, chromonyl, coumarinyl, benzopyranyl, cinnolinyl, quinoxalinyl, indazolyl, and pyrrolopyridyl.

The phrase “pharmaceutically acceptable” is employed herein to refer to those compounds, materials, compositions, and/or dosage forms which are, within the scope of sound medical judgment, suitable for use in contact with the tissues of human beings and animals without excessive toxicity, irritation, allergic response, or other problem or complication, commensurate with a reasonable benefit/risk ratio.

The compounds of the present invention can form salts which are also within the scope of this disclosure. Unless otherwise indicated, reference to an inventive compound is understood to include reference to one or more salts thereof. The term "salt(s)" denotes acidic and/or basic salts formed with inorganic and/or organic acids and bases. In addition, the term "salt(s) may include zwitterions (inner salts), *e.g.*, when a compound of the present invention contains both a basic moiety, such as an amine or a pyridine or imidazole ring, and an acidic moiety, such as a carboxylic acid. Pharmaceutically acceptable (*i.e.,* non-toxic, physiologically acceptable) salts are preferred, such as, for example, acceptable metal and amine salts in which the cation does not contribute significantly to the toxicity or biological activity of the salt. However, other salts may be useful, *e.g.*, in isolation or purification steps which may be employed during preparation, and thus, are contemplated within the scope of the disclosure. Salts of the compounds of the present invention may be formed, for example, by reacting a compound of the present invention with an amount of acid or base, such as an equivalent amount, in a medium such as one in which the salt precipitates or in an aqueous medium followed by lyophilization.

Exemplary acid addition salts include acetates (such as those formed with acetic acid or trihaloacetic acid, for example, trifluoroacetic acid), adipates, alginates, ascorbates, aspartates, benzoates, benzenesulfonates, bisulfates, borates, butyrates, citrates, camphorates, camphorsulfonates, cyclopentanepropionates, digluconates, dodecylsulfates, ethanesulfonates, fumarates, glucoheptanoates, glycerophosphates, hemisulfates, heptanoates, hexanoates, hydrochlorides (formed with hydrochloric acid), hydrobromides (formed with hydrogen bromide), hydroiodides, maleates (formed with maleic acid), 2-hydroxyethanesulfonates, lactates, methanesulfonates (formed with methanesulfonic acid), 2-naphthalenesulfonates, nicotinates, nitrates, oxalates, pectinates, persulfates, 3-phenylpropionates, phosphates, picrates, pivalates, propionates, salicylates, succinates, sulfates (such as those formed with sulfuric acid), sulfonates (such as those mentioned herein), tartrates, thiocyanates, toluenesulfonates such as tosylates, undecanoates, and the like.

Exemplary basic salts include ammonium salts, alkali metal salts such as sodium, lithium, and potassium salts; alkaline earth metal salts such as calcium and magnesium salts; barium, zinc, and aluminum salts; salts with organic bases (for example, organic

amines) such as trialkylamines such as triethylamine, procaine, dibenzylamine, N-benzyl-β-phenethylamine, 1-ephenamine, N,N′-dibenzylethylene-diamine, dehydroabietylamine, N-ethylpiperidine, benzylamine, dicyclohexylamine or similar pharmaceutically acceptable amines and salts with amino acids such as arginine, lysine and the like. Basic nitrogen-containing groups may be quaternized with agents such as lower alkyl halides (*e.g.,* methyl, ethyl, propyl, and butyl chlorides, bromides and iodides), dialkyl sulfates (*e.g.,* dimethyl, diethyl, dibutyl, and diamyl sulfates), long chain halides (*e.g.,* decyl, lauryl, myristyl and stearyl chlorides, bromides and iodides), aralkyl halides (*e.g.,* benzyl and phenethyl bromides), and others. Preferred salts include monohydrochloride, hydrogensulfate, methanesulfonate, phosphate or nitrate salts.

Various forms of prodrugs are well known in the art and are described in:

a) *The Practice of Medicinal Chemistry*, Camille G. Wermuth et al., Ch 31, (Academic Press, 1996);

b) *Design of Prodrugs*, edited by H. Bundgaard, (Elsevier, 1985);

c) *A Textbook of Drug Design and Development*, P. Krogsgaard–Larson and H. Bundgaard, eds. Ch 5, pgs 113 – 191 (Harwood Academic Publishers, 1991); and

d) *Hydrolysis in Drug and Prodrug Metabolism*, Bernard Testa and Joachim M. Mayer, (Wiley-VCH, 2003).

Compounds of the present disclosure may contain stereoisomers, wherein asymmetric or chiral centers are present. Specific stereochemistry may be designated by the symbols "R" or "S" depending on the configuration of substituents around the chiral carbon atom. The present invention contemplates various stereoisomers (i.e., enantiomers and diastereomers) and mixtures thereof and is intended to encompass all stereoisomers that bind to PD-L1. Individual stereoisomers of compounds of the present invention may be prepared synthetically from commercially available starting materials which contain asymmetric or chiral centers or by preparation of racemic mixtures followed by resolution well-known to those of ordinary skill in the art.

In addition, compounds of the present invention, subsequent to their preparation, can be isolated and purified to obtain a composition containing an amount by weight equal to or greater than 99% of a compound of the present invention ("substantially pure"), which is then used or formulated as described herein. Such "substantially pure"

compounds of the present invention are also contemplated herein as part of the present disclosure.

"Stable compound" and "stable structure" are meant to indicate a compound that is sufficiently robust to survive isolation to a useful degree of purity from a reaction mixture, and formulation into an efficacious therapeutic agent. The present disclosure is intended to embody stable compounds.

"Therapeutically effective amount" is intended to include an amount of a compound of the present disclosure alone or an amount of the combination of compounds claimed or an amount of a compound of the present disclosure in combination with other active ingredients effective to inhibit PD-1/PD-L1 protein/protein and/or CD80/PD-L1 protein/protein interactions, or effective to treat or prevent cancer or infectious disease, such as septic shock, HIV or Hepatitis B, Hepatitis C, and Hepatitis D.

As used herein, "treating" or "treatment" cover the treatment of a disease-state in a mammal, particularly in a human, and may include: (a) preventing the disease-state from occurring in a mammal, in particular, when such mammal is predisposed to the disease-state but has not yet been diagnosed as having it; (b) inhibiting the disease-state, i.e., arresting its development; and/or (c) relieving the disease-state, i.e., causing regression of the disease state.

The compounds of the present disclosure are intended to include all isotopes of atoms occurring in the present compounds. Isotopes include those atoms having the same atomic number but different mass numbers. By way of general example and without limitation, isotopes of hydrogen include deuterium (D) and tritium (T). Isotopes of carbon include ^{13}C and ^{14}C. Isotopically-labeled compounds of the disclosure can generally be prepared by conventional techniques known to those skilled in the art or by processes analogous to those described herein, using an appropriate isotopically-labeled reagent in place of the non-labeled reagent otherwise employed. For example, methyl (-CH_3) also includes deuterated methyl groups such as -CD_3.

Compounds in accordance with the present invention and/or pharmaceutically acceptable salts thereof can be administered by any means suitable for the condition to be treated, which can depend on the need for site-specific treatment or quantity of the present invention compound to be delivered. Also embraced within this disclosure is a class of pharmaceutical compositions comprising a compound of the present invention

and/or pharmaceutically acceptable salts thereof; and one or more non-toxic, pharmaceutically-acceptable carriers and/or diluents and/or adjuvants (collectively referred to herein as "carrier" materials) and, if desired, other active ingredients. The compounds of the present invention may be administered by any suitable route, preferably in the form of a pharmaceutical composition adapted to such a route, and in a dose effective for the treatment intended. The compounds and compositions of the present disclosure may, for example, be administered orally, mucosally, rectally, or parentally including intravascularly, intravenously, intraperitoneally, subcutaneously, intramuscularly, and intrasternally in dosage unit formulations containing conventional pharmaceutically acceptable carriers, adjuvants, and vehicles. For example, the pharmaceutical carrier may contain a mixture of mannitol or lactose and microcrystalline cellulose. The mixture may contain additional components such as a lubricating agent, e.g. magnesium stearate and a disintegrating agent such as crospovidone. The carrier mixture may be filled into a gelatin capsule or compressed as a tablet. The pharmaceutical composition may be administered as an oral dosage form or an infusion, for example.

For oral administration, the pharmaceutical composition may be in the form of, for example, a tablet, capsule, liquid capsule, suspension, or liquid. The pharmaceutical composition is preferably made in the form of a dosage unit containing a particular amount of the active ingredient. For example, the pharmaceutical composition may be provided as a tablet or capsule comprising an amount of active ingredient in the range of from about 0.1 to 1000 mg, preferably from about 0.25 to 250 mg, and more preferably from about 0.5 to 100 mg. A suitable daily dose for a human or other mammal may vary widely depending on the condition of the patient and other factors, but, can be determined using routine methods.

Any pharmaceutical composition contemplated herein can, for example, be delivered orally via any acceptable and suitable oral preparations. Exemplary oral preparations, include, but are not limited to, for example, tablets, troches, lozenges, aqueous and oily suspensions, dispersible powders or granules, emulsions, hard and soft capsules, liquid capsules, syrups, and elixirs. Pharmaceutical compositions intended for oral administration can be prepared according to any methods known in the art for manufacturing pharmaceutical compositions intended for oral administration. In order to

provide pharmaceutically palatable preparations, a pharmaceutical composition in accordance with the disclosure can contain at least one agent selected from sweetening agents, flavoring agents, coloring agents, demulcents, antioxidants, and preserving agents.

A tablet can, for example, be prepared by admixing at least one compound of the present invention and/or at least one pharmaceutically acceptable salt thereof with at least one non-toxic pharmaceutically acceptable excipient suitable for the manufacture of tablets. Exemplary excipients include, but are not limited to, for example, inert diluents, such as, for example, calcium carbonate, sodium carbonate, lactose, calcium phosphate, and sodium phosphate; granulating and disintegrating agents, such as, for example, microcrystalline cellulose, sodium crosscarmellose, corn starch, and alginic acid; binding agents, such as, for example, starch, gelatin, polyvinyl-pyrrolidone, and acacia; and lubricating agents, such as, for example, magnesium stearate, stearic acid, and talc. Additionally, a tablet can either be uncoated, or coated by known techniques to either mask the bad taste of an unpleasant tasting drug, or delay disintegration and absorption of the active ingredient in the gastrointestinal tract thereby sustaining the effects of the active ingredient for a longer period. Exemplary water soluble taste masking materials, include, but are not limited to, hydroxypropyl-methylcellulose and hydroxypropyl-cellulose. Exemplary time delay materials, include, but are not limited to, ethyl cellulose and cellulose acetate butyrate.

Hard gelatin capsules can, for example, be prepared by mixing at least one compound of the present invention and/or at least one salt thereof with at least one inert solid diluent, such as, for example, calcium carbonate; calcium phosphate; and kaolin.

Soft gelatin capsules can, for example, be prepared by mixing at least one compound of the present invention and/or at least one pharmaceutically acceptable salt thereof with at least one water soluble carrier, such as, for example, polyethylene glycol; and at least one oil medium, such as, for example, peanut oil, liquid paraffin, and olive oil.

An aqueous suspension can be prepared, for example, by admixing at least one compound of the present invention and/or at least one pharmaceutically acceptable salt thereof with at least one excipient suitable for the manufacture of an aqueous suspension. Exemplary excipients suitable for the manufacture of an aqueous suspension, include, but are not limited to, for example, suspending agents, such as, for example, sodium

carboxymethylcellulose, methylcellulose, hydroxypropylmethyl-cellulose, sodium alginate, alginic acid, polyvinyl-pyrrolidone, gum tragacanth, and gum acacia; dispersing or wetting agents, such as, for example, a naturally-occurring phosphatide, e.g., lecithin; condensation products of alkylene oxide with fatty acids, such as, for example, polyoxyethylene stearate; condensation products of ethylene oxide with long chain aliphatic alcohols, such as, for example heptadecaethylene-oxycetanol; condensation products of ethylene oxide with partial esters derived from fatty acids and hexitol, such as, for example, polyoxyethylene sorbitol monooleate; and condensation products of ethylene oxide with partial esters derived from fatty acids and hexitol anhydrides, such as, for example, polyethylene sorbitan monooleate. An aqueous suspension can also contain at least one preservative, such as, for example, ethyl and n-propyl p-hydroxybenzoate; at least one coloring agent; at least one flavoring agent; and/or at least one sweetening agent, including but not limited to, for example, sucrose, saccharin, and aspartame.

Oily suspensions can, for example, be prepared by suspending at least one compound of the present invention and/or at least one pharmaceutically acceptable salt thereof in either a vegetable oil, such as, for example, arachis oil; olive oil; sesame oil; and coconut oil; or in mineral oil, such as, for example, liquid paraffin. An oily suspension can also contain at least one thickening agent, such as, for example, beeswax; hard paraffin; and cetyl alcohol. In order to provide a palatable oily suspension, at least one of the sweetening agents already described hereinabove, and/or at least one flavoring agent can be added to the oily suspension. An oily suspension can further contain at least one preservative, including, but not limited to, for example, an anti-oxidant, such as, for example, butylated hydroxyanisol, and alpha-tocopherol.

Dispersible powders and granules can, for example, be prepared by admixing at least one compound of the present invention and/or at least one pharmaceutically acceptable salt thereof with at least one dispersing and/or wetting agent; at least one suspending agent; and/or at least one preservative. Suitable dispersing agents, wetting agents, and suspending agents are as already described above. Exemplary preservatives include, but are not limited to, for example, anti-oxidants, e.g., ascorbic acid. In addition, dispersible powders and granules can also contain at least one excipient, including, but not limited to, for example, sweetening agents; flavoring agents; and coloring agents.

An emulsion of at least one compound of the present invention and/or at least one pharmaceutically acceptable salt thereof can, for example, be prepared as an oil-in-water emulsion. The oily phase of the emulsions comprising compounds of the present invention may be constituted from known ingredients in a known manner. The oil phase can be provided by, but is not limited to, for example, a vegetable oil, such as, for example, olive oil and arachis oil; a mineral oil, such as, for example, liquid paraffin; and mixtures thereof. While the phase may comprise merely an emulsifier, it may comprise a mixture of at least one emulsifier with a fat or an oil or with both a fat and an oil. Suitable emulsifying agents include, but are not limited to, for example, naturally-occurring phosphatides, e.g., soy bean lecithin; esters or partial esters derived from fatty acids and hexitol anhydrides, such as, for example, sorbitan monooleate; and condensation products of partial esters with ethylene oxide, such as, for example, polyoxyethylene sorbitan monooleate. Preferably, a hydrophilic emulsifier is included together with a lipophilic emulsifier which acts as a stabilizer. It is also preferred to include both an oil and a fat. Together, the emulsifier(s) with or without stabilizer(s) make-up the so-called emulsifying wax, and the wax together with the oil and fat make up the so-called emulsifying ointment base which forms the oily dispersed phase of the cream formulations. An emulsion can also contain a sweetening agent, a flavoring agent, a preservative, and/or an antioxidant. Emulsifiers and emulsion stabilizers suitable for use in the formulation of the present disclosure include Tween 60, Span 80, cetostearyl alcohol, myristyl alcohol, glyceryl monostearate, sodium lauryl sulfate, glyceryl distearate alone or with a wax, or other materials well known in the art.

The compounds of the present invention and/or at least one pharmaceutically acceptable salt thereof can, for example, also be delivered intravenously, subcutaneously, and/or intramuscularly via any pharmaceutically acceptable and suitable injectable form. Exemplary injectable forms include, but are not limited to, for example, sterile aqueous solutions comprising acceptable vehicles and solvents, such as, for example, water, Ringer's solution, and isotonic sodium chloride solution; sterile oil-in-water microemulsions; and aqueous or oleaginous suspensions.

Formulations for parenteral administration may be in the form of aqueous or non-aqueous isotonic sterile injection solutions or suspensions. These solutions and suspensions may be prepared from sterile powders or granules using one or more of the

carriers or diluents mentioned for use in the formulations for oral administration or by using other suitable dispersing or wetting agents and suspending agents. The compounds may be dissolved in water, polyethylene glycol, propylene glycol, ethanol, corn oil, cottonseed oil, peanut oil, sesame oil, benzyl alcohol, sodium chloride, tragacanth gum, and/or various buffers. Other adjuvants and modes of administration are well and widely known in the pharmaceutical art. The active ingredient may also be administered by injection as a composition with suitable carriers including saline, dextrose, or water, or with cyclodextrin (i.e. Captisol), cosolvent solubilization (i.e. propylene glycol) or micellar solubilization (i.e. Tween 80).

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-butanediol. 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.

A sterile injectable oil-in-water microemulsion can, for example, be prepared by 1) dissolving at least one compound of the present invention in an oily phase, such as, for example, a mixture of soybean oil and lecithin; 2) combining the the present invention containing oil phase with a water and glycerol mixture; and 3) processing the combination to form a microemulsion.

A sterile aqueous or oleaginous suspension can be prepared in accordance with methods already known in the art. For example, a sterile aqueous solution or suspension can be prepared with a non-toxic parenterally-acceptable diluent or solvent, such as, for example, 1,3-butane diol; and a sterile oleaginous suspension can be prepared with a sterile non-toxic acceptable solvent or suspending medium, such as, for example, sterile fixed oils, e.g., synthetic mono- or diglycerides; and fatty acids, such as, for example, oleic acid.

Pharmaceutically acceptable carriers, adjuvants, and vehicles that may be used in the pharmaceutical compositions of this disclosure include, but are not limited to, ion exchangers, alumina, aluminum stearate, lecithin, self-emulsifying drug delivery systems

(SEDDS) such as d-alpha-tocopherol polyethyleneglycol 1000 succinate, surfactants used in pharmaceutical dosage forms such as Tweens, polyethoxylated castor oil such as CREMOPHOR surfactant (BASF), or other similar polymeric delivery matrices, serum proteins, such as human serum albumin, buffer substances such as phosphates, glycine, sorbic acid, potassium sorbate, partial glyceride mixtures of saturated vegetable fatty acids, water, salts or electrolytes, such as protamine sulfate, disodium hydrogen phosphate, potassium hydrogen phosphate, sodium chloride, zinc salts, colloidal silica, magnesium trisilicate, polyvinyl pyrrolidone, cellulose-based substances, polyethylene glycol, sodium carboxymethylcellulose, polyacrylates, waxes, polyethylene-polyoxypropylene-block polymers, polyethylene glycol and wool fat. Cyclodextrins such as alpha-, beta-, and gamma-cyclodextrin, or chemically modified derivatives such as hydroxyalkylcyclodextrins, including 2- and 3-hydroxypropyl-cyclodextrins, or other solubilized derivatives may also be advantageously used to enhance delivery of compounds of the formulae described herein.

The pharmaceutically active compounds of this disclosure can be processed in accordance with conventional methods of pharmacy to produce medicinal agents for administration to patients, including humans and other mammals. The pharmaceutical compositions may be subjected to conventional pharmaceutical operations such as sterilization and/or may contain conventional adjuvants, such as preservatives, stabilizers, wetting agents, emulsifiers, buffers etc. Tablets and pills can additionally be prepared with enteric coatings. Such compositions may also comprise adjuvants, such as wetting, sweetening, flavoring, and perfuming agents.

The amounts of compounds that are administered and the dosage regimen for treating a disease condition with the compounds and/or compositions of this disclosure depends on a variety of factors, including the age, weight, sex, the medical condition of the subject, the type of disease, the severity of the disease, the route and frequency of administration, and the particular compound employed. Thus, the dosage regimen may vary widely, but can be determined routinely using standard methods. A daily dose of about 0.001 to 100 mg/kg body weight, preferably between about 0.0025 and about 50 mg/kg body weight and most preferably between about 0.005 to 10 mg/kg body weight, may be appropriate. The daily dose can be administered in one to four doses per day. Other dosing schedules include one dose per week and one dose per two day cycle.

For therapeutic purposes, the active compounds of this disclosure are ordinarily combined with one or more adjuvants appropriate to the indicated route of administration. If administered orally, the compounds may be admixed with lactose, sucrose, starch powder, cellulose esters of alkanoic acids, cellulose alkyl esters, talc, stearic acid, magnesium stearate, magnesium oxide, sodium and calcium salts of phosphoric and sulfuric acids, gelatin, acacia gum, sodium alginate, polyvinylpyrrolidone, and/or polyvinyl alcohol, and then tableted or encapsulated for convenient administration. Such capsules or tablets may contain a controlled-release formulation as may be provided in a dispersion of active compound in hydroxypropylmethyl cellulose.

Pharmaceutical compositions of this disclosure comprise at least one compound of the present invention and/or at least one pharmaceutically acceptable salt thereof, and optionally an additional agent selected from any pharmaceutically acceptable carrier, adjuvant, and vehicle. Alternate compositions of this disclosure comprise a compound of the present invention described herein, or a prodrug thereof, and a pharmaceutically acceptable carrier, adjuvant, or vehicle.

The compounds of the disclosure inhibit the PD-1/PD-L1 protein/protein resulting in a PD-L1 blockade. The blockade of PD-L1 can enhance the immune response to cancerous cells and infectious diseases in mammals, including humans.

In one aspect, the present disclosure relates to treatment of a subject *in vivo* using a compound of the present invention or a salt thereof such that growth of cancerous tumors is inhibited. A compound of the present invention or a salt thereof may be used alone to inhibit the growth of cancerous tumors. Alternatively, a compound of the present invention or a salt thereof may be used in conjunction with other immunogenic agents or standard cancer treatments, as described below.

In one embodiment, the disclosure provides a method of inhibiting growth of tumor cells in a subject, comprising administering to the subject a therapeutically effective amount of a compound of the present invention or a salt thereof.

In one embodiment, a method is provided for treating cancer comprising administering to a patient in need thereof, a therapeutically effective amount of a compound of the present invention or a salt thereof. Examples of cancers include those whose growth may be inhibited using compounds of the disclosure include cancers typically responsive to immunotherapy. Non-limiting examples of preferred cancers for

treatment include melanoma (e.g., metastatic malignant melanoma), renal cancer (e.g. clear cell carcinoma), prostate cancer (e.g. hormone refractory prostate adenocarcinoma), breast cancer, colon cancer and lung cancer (e.g. non-small cell lung cancer). Additionally, the disclosure includes refractory or recurrent malignancies whose growth may be inhibited using the compounds of the disclosure.

Examples of other cancers that may be treated using the methods of the disclosure include bone cancer, pancreatic cancer, skin cancer, cancer of the head or neck, cutaneous or intraocular malignant melanoma, uterine cancer, ovarian cancer, rectal cancer, cancer of the anal region, stomach cancer, testicular cancer, uterine cancer, carcinoma of the fallopian tubes, carcinoma of the endometrium, carcinoma of the cervix, carcinoma of the vagina, carcinoma of the vulva, Hodgkin's Disease, non-Hodgkin's lymphoma, cancer of the esophagus, cancer of the small intestine, cancer of the endocrine system, cancer of the thyroid gland, cancer of the parathyroid gland, cancer of the adrenal gland, sarcoma of soft tissue, cancer of the urethra, cancer of the penis, chronic or acute leukemias including acute myeloid leukemia, chronic myeloid leukemia, acute lymphoblastic leukemia, chronic lymphocytic leukemia, solid tumors of childhood, lymphocytic lymphoma, cancer of the bladder, cancer of the kidney or urethra, carcinoma of the renal pelvis, neoplasm of the central nervous system (CNS), primary CNS lymphoma, tumor angiogenesis, spinal axis tumor, brain stem glioma, pituitary adenoma, Kaposi's sarcoma, epidermoid cancer, squamous cell cancer, T-cell lymphoma, environmentally induced cancers including those induced by asbestos, and combinations of said cancers. The present disclosure is also useful for treatment of metastatic cancers, especially metastatic cancers that express PD-L1 (Iwai *et al.* (2005) *Int. Immunol.* 17:133-144).

Optionally, the compounds of the present invention or salts thereof can be combined with another immunogenic agent, such as cancerous cells, purified tumor antigens (including recombinant proteins, peptides, and carbohydrate molecules), cells, and cells transfected with genes encoding immune stimulating cytokines (He et al (2004) J. Immunol. 173:4919-28). Non-limiting examples of tumor vaccines that can be used include peptides of melanoma antigens, such as peptides of gp100, MAGE antigens, Trp-2, MART1 and/or tyrosinase, or tumor cells transfected to express the cytokine GM-CSF.

In humans, some tumors have been shown to be immunogenic such as melanomas. It is anticipated that by raising the threshold of T cell activation by PD-L1 blockade, tumor responses are expected to be activated in the host.

The PD-L1 blockade can be combined with a vaccination protocol. Many experimental strategies for vaccination against tumors have been devised (see Rosenberg, S., 2000, Development of Cancer Vaccines, ASCO Educational Book Spring: 60-62; Logothetis, C., 2000, ASCO Educational Book Spring: 300-302; Khayat, D. 2000, ASCO Educational Book Spring: 414-428; Foon, K. 2000, ASCO Educational Book Spring: 730-738; see also Restifo, N. and Sznol, M., Cancer Vaccines, Ch. 61, pp. 3023-3043 in DeVita, V. et al. (eds.), 1997, Cancer: Principles and Practice of Oncology. Fifth Edition). In one of these strategies, a vaccine is prepared using autologous or allogenenic tumor cells. These cellular vaccines have been shown to be most effective when the tumor cells are transduced to express GM-CSF. GM-CSF has been shown to be a potent activator of antigen presentation for tumor vaccination (Dranoff et al. (1993) Proc. Natl. Acad. Sci. U.S.A. 90: 3539-43).

The study of gene expression and large scale gene expression patterns in various tumors has led to the definition of so called tumor specific antigens (Rosenberg, S A (1999) Immunity 10: 281-7). In many cases, these tumor specific antigens are differentiation antigens expressed in the tumors and in the cell from which the tumor arose, for example melanocyte antigens gp100, MAGE antigens, and Trp-2. More importantly, many of these antigens can be shown to be the targets of tumor specific T cells found in the host. PD-L1 blockade may be used in conjunction with a collection of recombinant proteins and/or peptides expressed in a tumor in order to generate an immune response to these proteins. These proteins are normally viewed by the immune system as self antigens and are therefore tolerant to them. The tumor antigen may also include the protein telomerase, which is required for the synthesis of telomeres of chromosomes and which is expressed in more than 85% of human cancers and in only a limited number of somatic tissues (Kim, N et al. (1994) Science 266: 2011-2013). (These somatic tissues may be protected from immune attack by various means). Tumor antigen may also be "neo-antigens" expressed in cancer cells because of somatic mutations that alter protein sequence or create fusion proteins between two unrelated sequences (ie. bcr-abl in the Philadelphia chromosome), or idiotype from B cell tumors.

Other tumor vaccines may include the proteins from viruses implicated in human cancers such a Human Papilloma Viruses (HPV), Hepatitis Viruses (HBV, HDV and HCV) and Kaposi's Herpes Sarcoma Virus (KHSV). Another form of tumor specific antigen which may be used in conjunction with PD-L1 blockade is purified heat shock proteins (HSP) isolated from the tumor tissue itself. These heat shock proteins contain fragments of proteins from the tumor cells and these HSPs are highly efficient at delivery to antigen presenting cells for eliciting tumor immunity (Suot, R & Srivastava, P (1995) Science 269:1585-1588; Tamura, Y. et al. (1997) Science 278:117-120).

Dendritic cells (DC) are potent antigen presenting cells that can be used to prime antigen-specific responses. DC's can be produced ex vivo and loaded with various protein and peptide antigens as well as tumor cell extracts (Nestle, F. et al. (1998) Nature Medicine 4: 328-332). DCs may also be transduced by genetic means to express these tumor antigens as well. DCs have also been fused directly to tumor cells for the purposes of immunization (Kugler, A. et al. (2000) Nature Medicine 6:332-336). As a method of vaccination, DC immunization may be effectively combined with PD-L1 blockade to activate more potent anti-tumor responses.

PD-L1 blockade may also be combined with standard cancer treatments. PD-L1 blockade may be effectively combined with chemotherapeutic regimes. In these instances, it may be possible to reduce the dose of chemotherapeutic reagent administered (Mokyr, M. *et al.* (1998) *Cancer Research* 58: 5301-5304). An example of such a combination is a compound of this disclosure in combination with dacarbazine for the treatment of melanoma. Another example of such a combination is a compound of this disclosure in combination with interleukin-2 (IL-2) for the treatment of melanoma. The scientific rationale behind the combined use of PD-L1 blockade and chemotherapy is that cell death, that is a consequence of the cytotoxic action of most chemotherapeutic compounds, should result in increased levels of tumor antigen in the antigen presentation pathway. Other combination therapies that may result in synergy with PD-L1 blockade through cell death are radiation, surgery, and hormone deprivation. Each of these protocols creates a source of tumor antigen in the host. Angiogenesis inhibitors may also be combined with PD-L1 blockade. Inhibition of angiogenesis leads to tumor cell death which may feed tumor antigen into host antigen presentation pathways.

The compounds of this disclosure can also be used in combination with bispecific compounds that target Fc alpha or Fc gamma receptor-expressing effectors cells to tumor cells (see, e.g., U.S. Pat. Nos. 5,922,845 and 5,837,243). Bispecific compounds can be used to target two separate antigens. For example anti-Fc receptor/anti tumor antigen (e.g., Her-2/neu) bispecific compounds have been used to target macrophages to sites of tumor. This targeting may more effectively activate tumor specific responses. The T cell arm of these responses would be augmented by the use of PD-L1 blockade. Alternatively, antigen may be delivered directly to DCs by the use of bispecific compounds which bind to tumor antigen and a dendritic cell specific cell surface marker.

Tumors evade host immune surveillance by a large variety of mechanisms. Many of these mechanisms may be overcome by the inactivation of proteins which are expressed by the tumors and which are immunosuppressive. These include among others TGF-beta (Kehrl, J. *et al.* (1986) *J. Exp. Med.* 163: 1037-1050), IL-10 (Howard, M. & O'Garra, A. (1992) *Immunology Today* 13: 198-200), and Fas ligand (Hahne, M. *et al.* (1996) Science 274: 1363-1365). Inhibitors that bind to and block each of these entities may be used in combination with the compounds of this disclosure to counteract the effects of the immunosuppressive agent and favor tumor immune responses by the host.

Compounds that activate host immune responsiveness can be used in combination with PD-L1 blockade. These include molecules on the surface of dendritic cells which activate DC function and antigen presentation. Anti-CD40 compounds are able to substitute effectively for T cell helper activity (Ridge, J. *et al.* (1998) *Nature* 393: 474-478) and can be used in conjunction with PD-L1 blockade (Ito, N. *et al.* (2000) *Immunobiology* 201 (5) 527-40). Activating compounds to T cell costimulatory molecules such as CTLA-4 (e.g., U.S. Pat. No. 5,811,097), OX-40 (Weinberg, A. *et al.* (2000) *Immunol* 164: 2160-2169), 4-1BB (Melero, I. *et al.* (1997) *Nature Medicine* 3: 682-685 (1997), and ICOS (Hutloff, A. *et al.* (1999) *Nature* 397: 262-266) may also provide for increased levels of T cell activation.

Bone marrow transplantation is currently being used to treat a variety of tumors of hematopoietic origin. While graft versus host disease is a consequence of this treatment, therapeutic benefit may be obtained from graft vs. tumor responses. PD-L1 blockade can be used to increase the effectiveness of the donor engrafted tumor specific T cells.

Other methods of the disclosure are used to treat patients who have been exposed to particular toxins or pathogens. Accordingly, another aspect of the disclosure provides a method of treating an infectious disease in a subject comprising administering to the subject a therapeutically effective amount of a compound of the present invention or salts thereof.

Similar to its application to tumors as discussed above, the compound of the present invention or salts thereof can be used alone, or as an adjuvant, in combination with vaccines, to stimulate the immune response to pathogens, toxins, and self-antigens. Examples of pathogens for which this therapeutic approach may be particularly useful, include pathogens for which there is currently no effective vaccine, or pathogens for which conventional vaccines are less than completely effective. These include, but are not limited to HIV, Hepatitis (A, B, C or D), Influenza, Herpes, Giardia, Malaria, Leishmania, Staphylococcus aureus, Pseudomonas Aeruginosa. PD-L1 blockade is particularly useful against established infections by agents such as HIV that present altered antigens over the course of the infections. These novel epitopes are recognized as foreign at the time of administration, thus provoking a strong T cell response that is not dampened by negative signals through PD-1.

Some examples of pathogenic viruses causing infections treatable by methods of the disclosure include HIV, hepatitis (A, B, C, or D), herpes viruses (e.g., VZV, HSV-1, HAV-6, HHv-7, HHV-8, HSV-2, CMV, and 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.

Some examples of pathogenic bacteria causing infections treatable by methods of the disclosure include chlamydia, rickettsial bacteria, mycobacteria, staphylococci, streptococci, pneumonococci, meningococci and conococci, klebsiella, proteus, serratia, pseudomonas, legionella, diphtheria, salmonella, bacilli, cholera, tetanus, botulism, anthrax, plague, leptospirosis, and Lymes disease bacteria.

Some examples of pathogenic fungi causing infections treatable by methods of the disclosure include 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.

Some examples of pathogenic parasites causing infections treatable by methods of the disclosure include Entamoeba histolytica, Balantidium coli, Naegleriafowleri, Acanthamoeba sp., Giardia lambia, Cryptosporidium sp., Pneumocystis carinii, Plasmodium vivax, Babesia microti, Trypanosoma brucei, Trypanosoma cruzi, Leishmania donovani, Toxoplasma gondi, and Nippostrongylus brasiliensis.

In all of the above methods, PD-L1 blockade can be combined with other forms of immunotherapy such as cytokine treatment (e.g., interferons, GM-CSF, G-CSF, IL-2), or bispecific antibody therapy, which provides for enhanced presentation of tumor antigens (see, e.g., Holliger (1993) Proc. Natl. Acad. Sci. USA 90:6444-6448; Poljak (1994) Structure 2:1121-1123), vaccines, or agents that modify gene expression.

The compounds of this disclosure may provoke and amplify autoimmune responses. Indeed, induction of anti-tumor responses using tumor cell and peptide vaccines reveals that many anti-tumor responses involve anti-self reactivities (depigmentation observed in anti-CTLA-4+GM-CSF-modified B 16 melanoma in van Elsas et al. supra; depigmentation in Trp-2 vaccinated mice (Overwijk, W. et al. (1999) *Proc. Natl. Acad. Sci. U.S.A.* 96: 2982-2987); autoimmune prostatitis evoked by TRAMP tumor cell vaccines (Hurwitz, A. (2000) supra), melanoma peptide antigen vaccination and vitilago observed in human clinical trials (Rosenberg, S A and White, D E (1996) *J. Immunother Emphasis Tumor Immunol* 19 (1): 81-4).

Therefore, it is possible to consider using anti-PD-L1 blockade in conjunction with various self proteins in order to devise vaccination protocols to efficiently generate immune responses against these self proteins for disease treatment. For example, Alzheimer's disease involves inappropriate accumulation of A.beta.peptide in amyloid deposits in the brain; antibody responses against amyloid are able to clear these amyloid deposits (Schenk et al., (1999) Nature 400: 173-177).

Other self proteins may also be used as targets such as IgE for the treatment of allergy and asthma, and TNF.alpha. for rheumatoid arthritis. Finally, antibody responses to various hormones may be induced by the use of a compound of the present invention or salts thereof. Neutralizing antibody responses to reproductive hormones may be used for contraception. Neutralizing antibody response to hormones and other soluble factors that

are required for the growth of particular tumors may also be considered as possible vaccination targets.

Analogous methods as described above for the use of anti-PD-L1 antibody can be used for induction of therapeutic autoimmune responses to treat patients having an inappropriate accumulation of other self-antigens, such as amyloid deposits, including A.beta. in Alzheimer's disease, cytokines such as TNF alpha, and IgE.

The compounds of this disclosure may be used to stimulate antigen-specific immune responses by co-administration of a compound of the present invention or salts thereof with an antigen of interest (e.g., a vaccine). Accordingly, in another aspect the disclosure provides a method of enhancing an immune response to an antigen in a subject, comprising administering to the subject: (i) the antigen; and (ii) a compound of the present invention or salts thereof, such that an immune response to the antigen in the subject is enhanced. The antigen can be, for example, a tumor antigen, a viral antigen, a bacterial antigen or an antigen from a pathogen. Non-limiting examples of such antigens include those discussed in the sections above, such as the tumor antigens (or tumor vaccines) discussed above, or antigens from the viruses, bacteria or other pathogens described above.

As previously described, the compounds of the disclosure can be co-administered with one or more other therapeutic agents, e.g., a cytotoxic agent, a radiotoxic agent or an immunosuppressive agent. The compounds of the disclosure can be administered before, after or concurrently with the other therapeutic agent or can be co-administered with other known therapies, e.g., an anti-cancer therapy, e.g., radiation. Such therapeutic agents include, among others, anti-neoplastic agents such as doxorubicin (adriamycin), cisplatin bleomycin sulfate, carmustine, chlorambucil, decarbazine and cyclophosphamide hydroxyurea which, by themselves, are only effective at levels which are toxic or subtoxic to a patient. Cisplatin is intravenously administered as a 100 mg/dose once every four weeks and adriamycin is intravenously administered as a 60-75 mg/ mL dose once every 21 days. Co-administration of a compound of the present invention or salts thereof, with chemotherapeutic agents provides two anti-cancer agents which operate via different mechanisms which yield a cytotoxic effect to human tumor cells. Such co-administration can solve problems due to development of resistance to drugs or a change

in the antigenicity of the tumor cells which would render them unreactive with the antibody.

Also within the scope of the present disclosure are kits comprising a compound of the present invention or 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.

The above other therapeutic agents, when employed in combination with the compounds of the present disclosure, may be used, for example, in those amounts indicated in the Physicians' Desk Reference (PDR) or as otherwise determined by one of ordinary skill in the art. In the methods of the present disclosure, such other therapeutic agent(s) may be administered prior to, simultaneously with, or following the administration of the inventive compounds.

EXAMPLES

The invention is further defined in the following Examples. It should be understood that the Examples are given by way of illustration only. From the above discussion and the Examples, one skilled in the art can ascertain the essential characteristics of the invention, and without departing from the spirit and scope thereof, can make various changes and modifications to adapt the invention to various uses and conditions. As a result, the invention is not limited by the illustrative examples set forth hereinbelow, but rather is defined by the claims appended hereto.

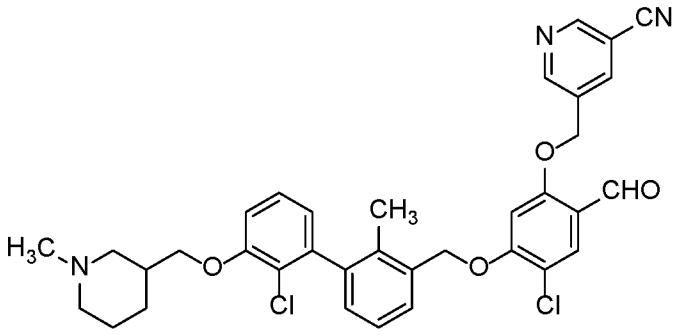
The compounds may be made by methods known in the art including those described below and including variations within the skill of the art. Some reagents and intermediates are known in the art. Other reagents and intermediates can be made by methods known in the art using readily available materials. The variables (e.g. numbered "R" substituents) used to describe the synthesis of the compounds are intended only to illustrate how to make the compounds and are not to be confused with variables used in the claims or in other sections of the specification. The following methods are for illustrative purposes and are not intended to limit the scope of the invention.

Abbreviations used in the schemes generally follow conventions used in the art. Chemical abbreviations used in the specification and examples are defined as follows:

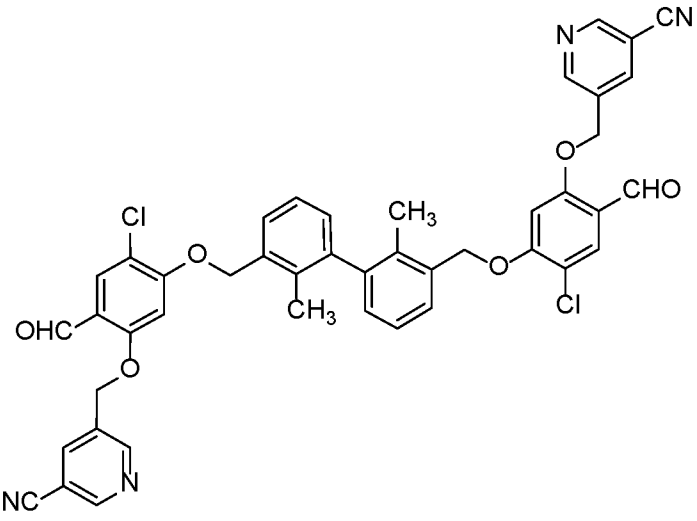
"THF" for tetrahydrofuran; "DMF" for N,N-dimethylformamide; “MeOH” for methanol; “EtOH” for ethanol; “n-PrOH” for 1-propyl alcohol or propan-1-ol; “i-PrOH” for 2-propyl alcohol or propan-2-ol; “Ar” for aryl; "TFA" for trifluoroacetic acid; “DMSO” for dimethylsulfoxide; "EtOAc" for ethyl acetate; “Et_2O” for diethyl ether; "DMAP" for 4-dimethylaminopyridine; “DCE” for 1,2-dichloroethane; “ACN” for acetonitrile; “DME” for 1,2-dimethoxyethane; “h” for hours; “rt” for room temperature or retention time (context will dictate); “min” for minutes; “HOBt” for 1-hydroxybenzotriazole hydrate; “HCTU” for 1-[bis(dimethylamino)methylen]-5-chlorobenzotriazolium 3-oxide hexafluorophosphate or *N*,*N*,*N*',*N*'-tetramethyl-*O*-(6-chloro-1*H*-benzotriazol-1-yl)uronium hexafluorophosphate; “HATU” for 1-[bis(dimethylamino)methylene]-1*H*-1,2,3-triazolo[4,5-*b*]pyridinium 3-oxid hexafluorophosphate or *N*-[(dimethylamino)-1*H*-1,2,3-triazolo-[4,5-*b*]pyridin-1-ylmethylene]-*N*-methylmethanaminium hexafluorophosphate *N*-oxide; “DIEA” and “$iPrNEt_2$” for diisopropylethylamine; “Et_3N” for triethyl amine.

Abbreviations are defined as follows: “1 x” for once, “2 x” for twice, “3 x” for thrice, "°C" for degrees Celsius, “eq” for equivalent or equivalents, “g” for gram or grams, “mg” for milligram or milligrams, “L” for liter or liters, “mL” for milliliter or milliliters, “μL” for microliter or microliters, “N” for normal, “M” for molar, “mmol” for millimole or millimoles, “min” for minute or minutes, “h” for hour or hours, “rt” for room temperature, “RT” for retention time, “atm” for atmosphere, “psi” for pounds per square inch, “conc.” for concentrate, “sat” or “sat’d “ for saturated, “MW” for molecular weight, “mp” for melting point, “ee” for enantiomeric excess, “MS” or “Mass Spec” for mass spectrometry, “ESI” for electrospray ionization mass spectroscopy, “HR” for high resolution, “HRMS” for high resolution mass spectrometry, “LC” for liquid chromatography, “LCMS” for liquid chromatography mass spectrometry, “HPLC” for high pressure liquid chromatography, “RP HPLC” for reverse phase HPLC, “TLC” or “tlc” for thin layer chromatography, “NMR” for nuclear magnetic resonance spectroscopy, “^1H” for proton, “δ” for delta, “s” for singlet, “d” for doublet, “t” for triplet, “q” for quartet, “m” for multiplet, “br” for broad, “Hz” for hertz, and “α”, “β”, “R”, “S”, “E”, and “Z” are stereochemical designations familiar to one skilled in the art.

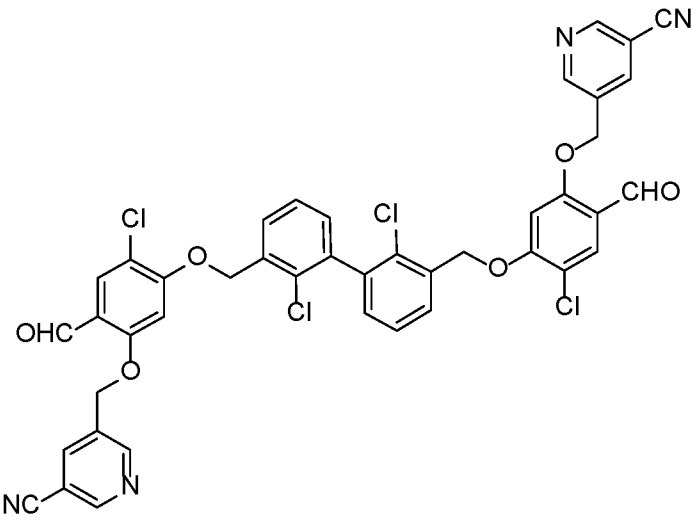
Intermediate 1:



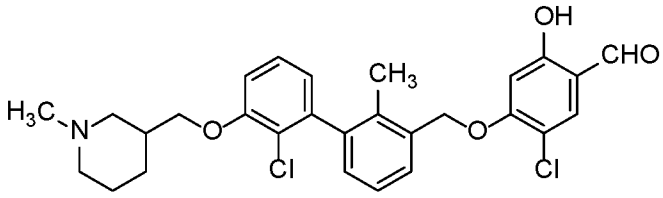
Intermediate 2:

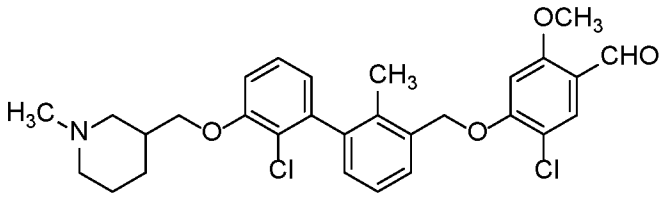


Intermediate 3:



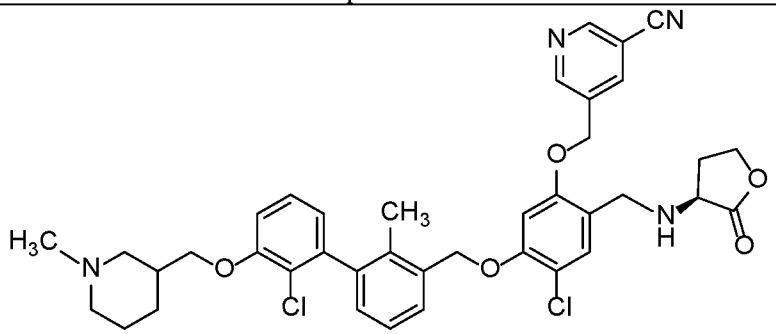
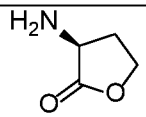
Intermediate 4:



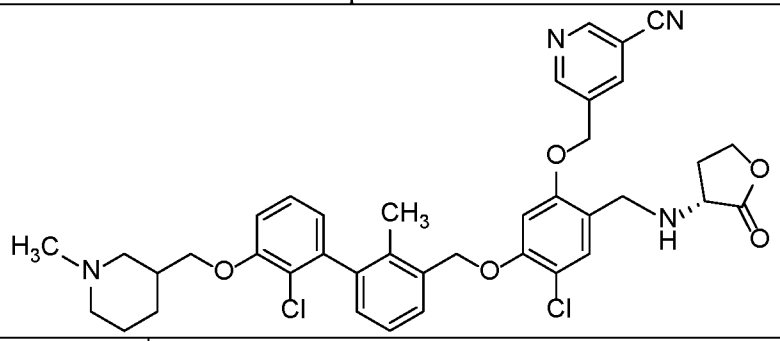
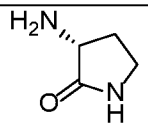
Intermediate 5: 

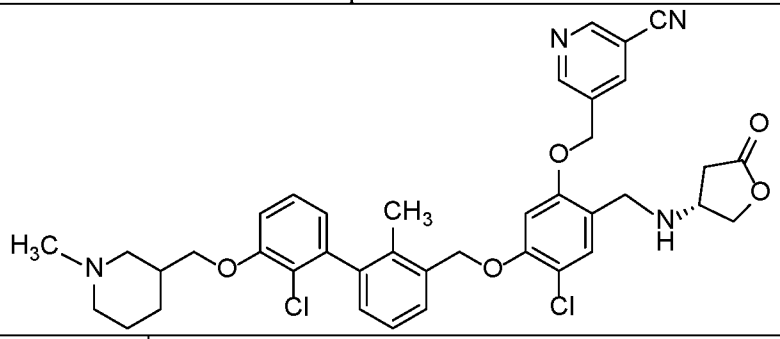
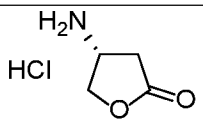
General Procedure for the preparation of compounds of the present invention, from Intermediates 1 to 5 and amino amino lactones or lactams:

A mixture of any one of Intermediates 1 to 5 (1 eq.) and an agent (1 - 20 eq.) in THF or dioxane or DME or MeOH or EtOH or their co-solvents, with or without AcOH (1 - 20 eq.), was stirred at room temperature for 0.5 to 48 hours, before $NaCNBH_3$ (1 - 20 eq.) was added. The reaction was stirred at room temperature to 100 °C for 0.5 to 48 hours, before being quenched with methanol or water. After all the solvents were removed under vacuum, the residue was purified by the preparative HPLC to give a compound of the present invention.

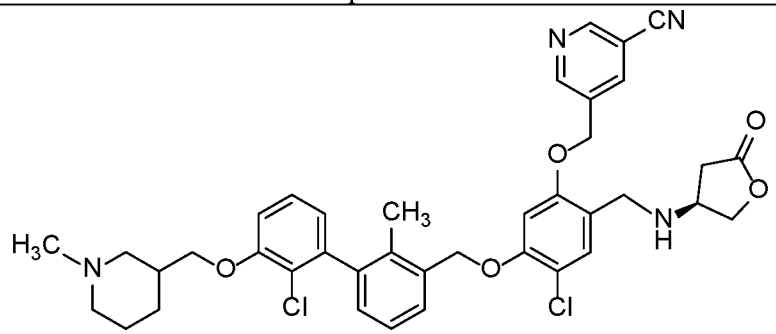
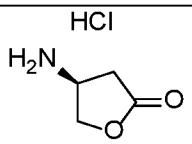
Compound 1001	
	
Starting Material	Intermediate 1
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	715.2
MS $(M + H)^+$ Observ.	715.3
Retention Time	1.89 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220

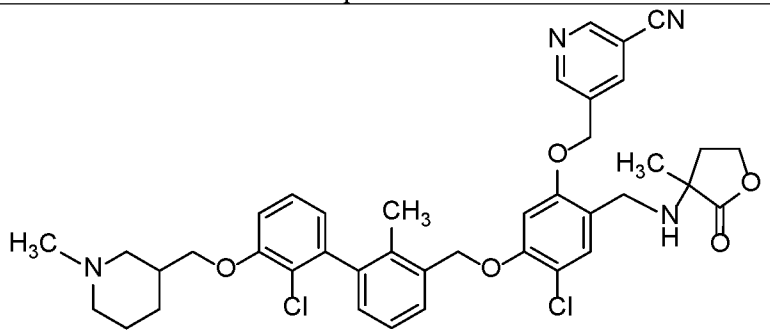
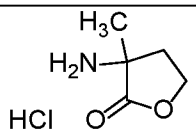
Temperature	40 °C
Column	Phenomenex LUNA C18, 30x2, 3u

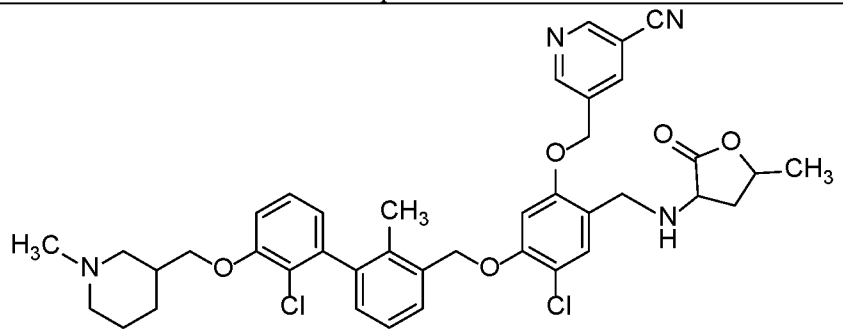
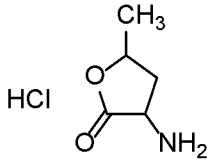
Compound 1002	
	
Starting Material	Intermediate 1
Agent Used	
MS	
MS (M + H)$^+$ Calcd.	715.2
MS (M + H)$^+$ Observ.	715.3
Retention Time	1.83 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 30x2, 3u

Compound 1003	
	
Starting Material	Intermediate 1
Agent Used	
MS	
MS (M + H)$^+$ Calcd.	715.2

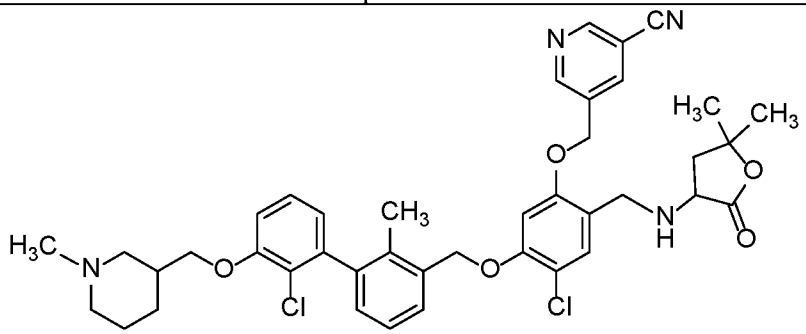
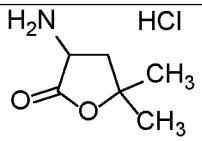
MS (M + H)$^+$ Observ.	715.3
Retention Time	1.89 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 30x2, 3u

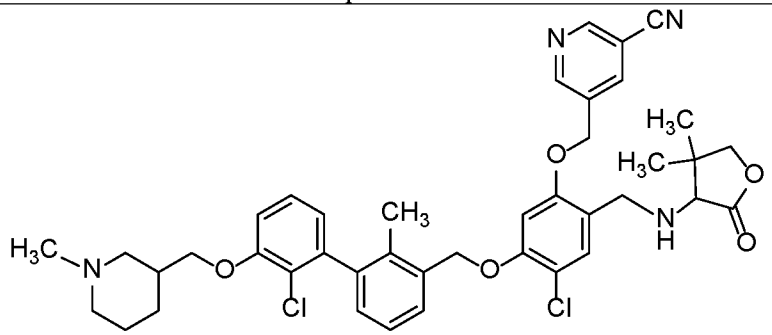
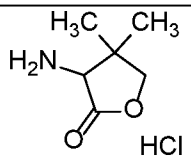
Compound 1004	
	
Starting Material	Intermediate 1
Agent Used	
MS	
MS (M + H)$^+$ Calcd.	715.2
MS (M + H)$^+$ Observ.	715.3
Retention Time	1.88 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 30x2, 3u

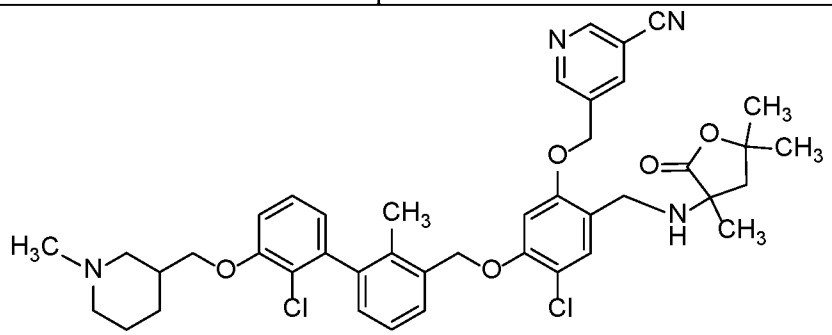
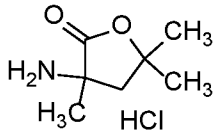
Compound 1005	
	
Starting Material	Intermediate 1
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	729.3
MS $(M + H)^+$ Observ.	729.3
Retention Time	2.05 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 30x2, 3u

Compound 1006	
	
Starting Material	Intermediate 1
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	729.3
MS $(M + H)^+$ Observ.	729.1
Retention Time	2.04 min

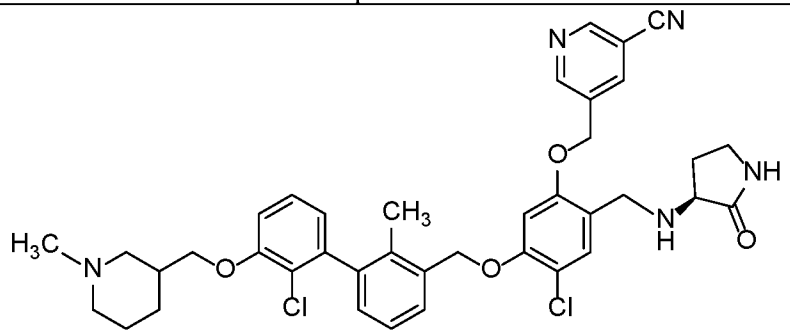
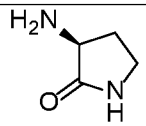
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 30x2, 3u

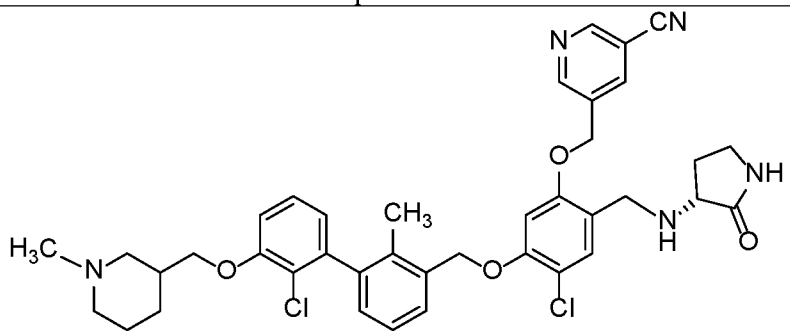
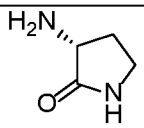
Compound 1007	
	
Starting Material	Intermediate 1
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	743.3
MS $(M + H)^+$ Observ.	743.4
Retention Time	2.12 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 30x2, 3u

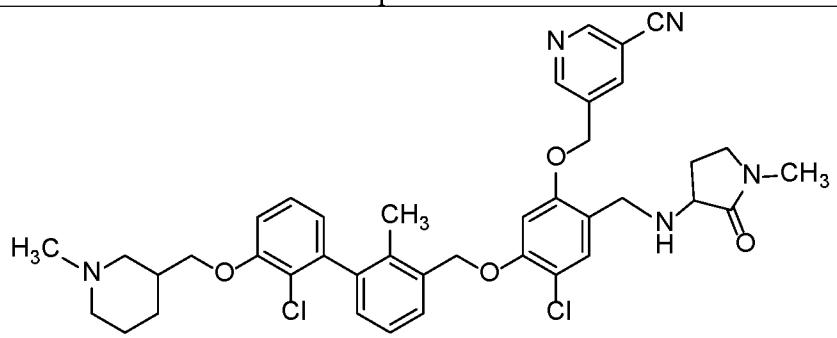
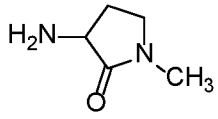
Compound 1008	
	
Starting Material	Intermediate 1
Agent Used	
MS	
MS (M + H)$^+$ Calcd.	743.3
MS (M + H)$^+$ Observ.	743.3
Retention Time	2.17 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 30x2, 3u

Compound 1009	
	
Starting Material	Intermediate 1
Agent Used	
MS	
MS (M + H)$^+$ Calcd.	757.3
MS (M + H)$^+$ Observ.	757.3
Retention Time	2.17 min

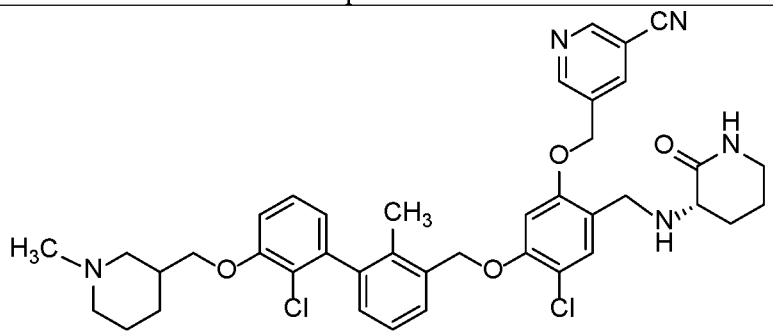
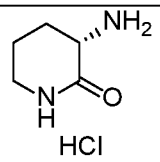
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 30x2, 3u

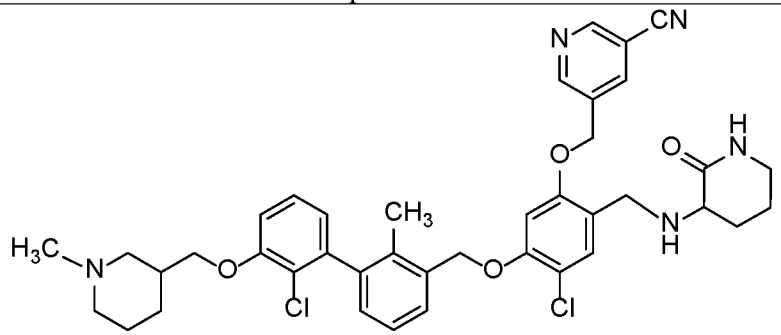
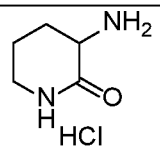
Compound 1010	
	
Starting Material	Intermediate 1
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	714.3
MS $(M + H)^+$ Observ.	714.2
Retention Time	1.87 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 30x2, 3u

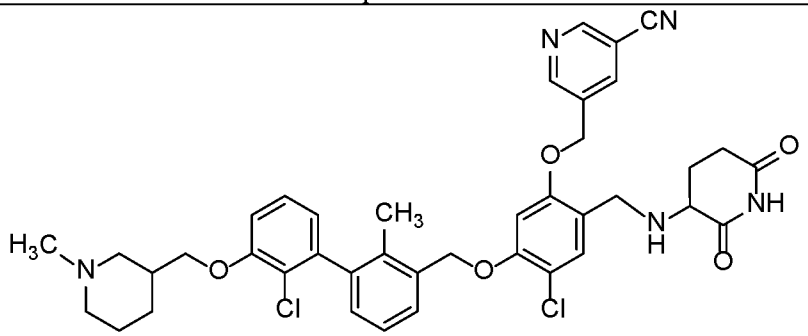
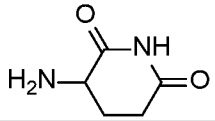
Compound 1011	
	
Starting Material	Intermediate 1
Agent Used	
MS	
MS (M + H)$^+$ Calcd.	714.3
MS (M + H)$^+$ Observ.	714.3
Retention Time	1.87 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 10 mM ammonium acetate
Solvent B	95:5 acetonitrile:water with 10 mM ammonium acetate
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 µm particles

Compound 1012	
	
Starting Material	Intermediate 1
Agent Used	
MS	
MS (M + H)$^+$ Calcd.	728.3
MS (M + H)$^+$ Observ.	728.3
Retention Time	1.93 min
LC Condition	

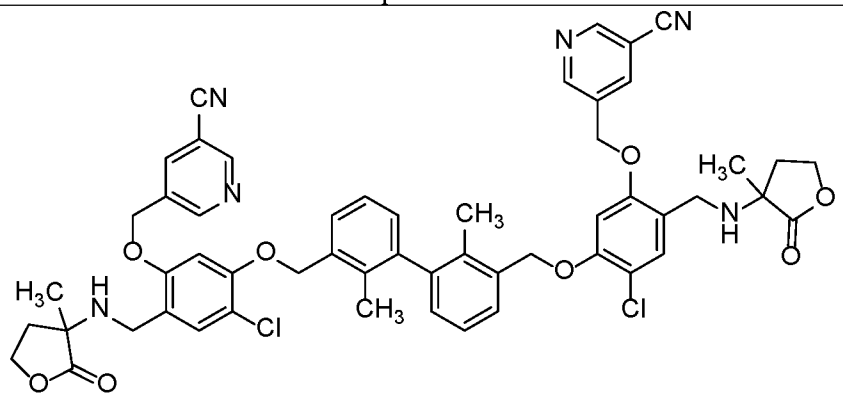
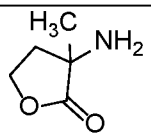
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 30x2, 3u

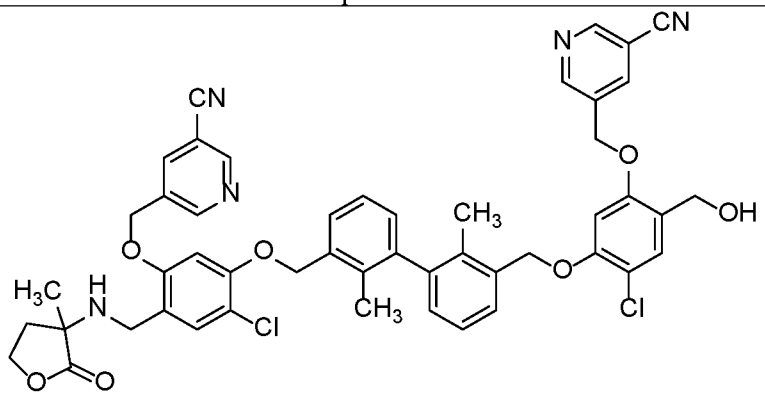
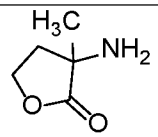
Compound 1013	
	
Starting Material	Intermediate 1
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	728.3
MS $(M + H)^+$ Observ.	728.3
Retention Time	1.96 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 30x2, 3u

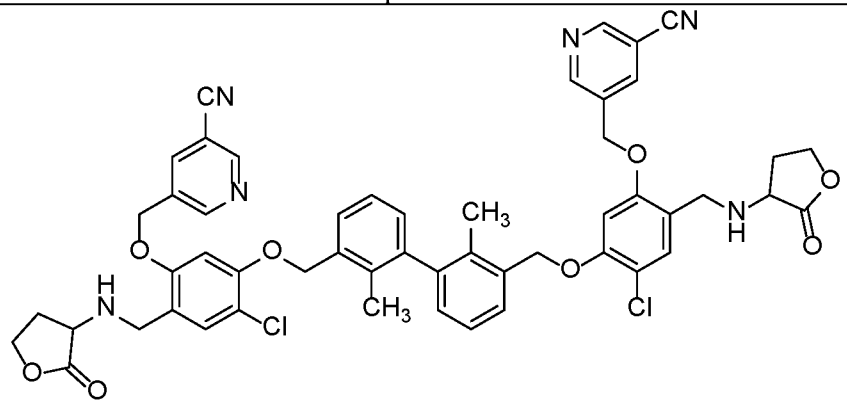
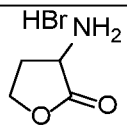
Compound 1014	
	
Starting Material	Intermediate 1
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	728.3
MS $(M + H)^+$ Observ.	728.2
Retention Time	1.81 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 10 mM ammonium acetate
Solvent B	95:5 acetonitrile:water with 10 mM ammonium acetate
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

Compound 1015	
	
Starting Material	Intermediate 1
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	742.2
MS $(M + H)^+$ Observ.	742.3
Retention Time	1.84 min
LC Condition	

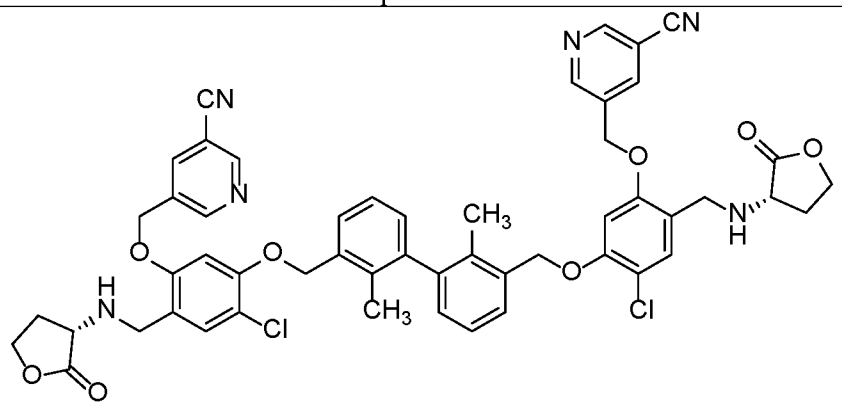
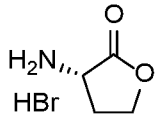
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	0
Final % B	100
Gradient Time	2 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 30x2, 3u

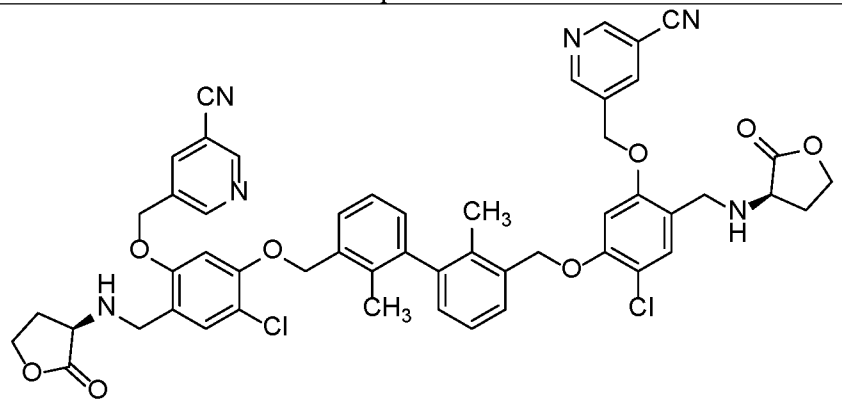
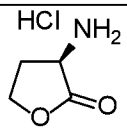
Compound 1016	
	
Starting Material	Intermediate 2
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	981.3
MS $(M + H)^+$ Observ.	981.5
Retention Time	3.06 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	40
Final % B	100
Gradient Time	4 min
Flow Rate	0.8 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 50x2, 3u

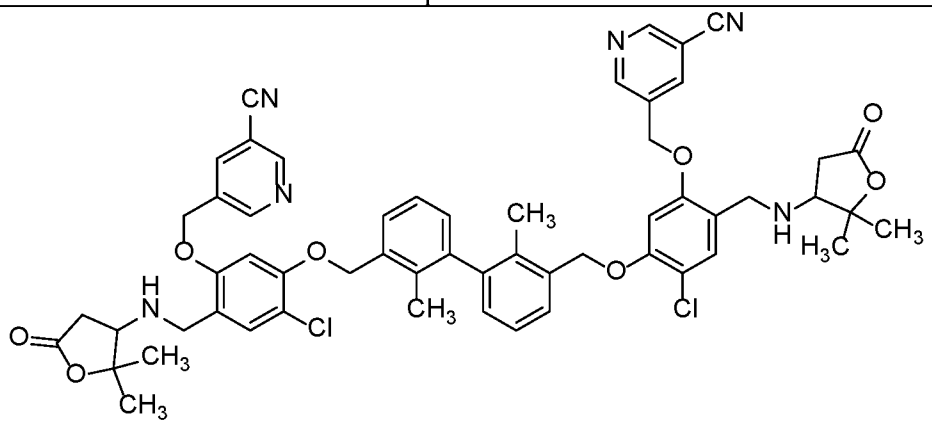
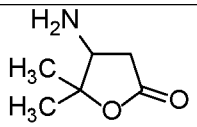
Compound 1017	
	
Starting Material	Intermediate 2
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	884.3
MS $(M + H)^+$ Observ.	884.1
Retention Time	2.66 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 10 mM ammonium acetate
Solvent B	95:5 acetonitrile:water with 10 mM ammonium acetate
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

Compound 1018	
	
Starting Material	Intermediate 2
Agent Used	
MS	

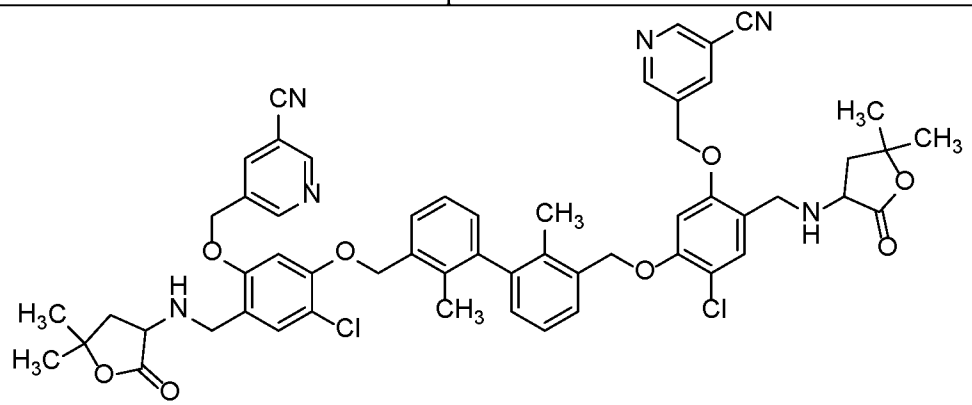
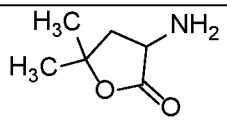
MS (M + H)$^+$ Calcd.	953.3
MS (M + H)$^+$ Observ.	953.1
Retention Time	2.02 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

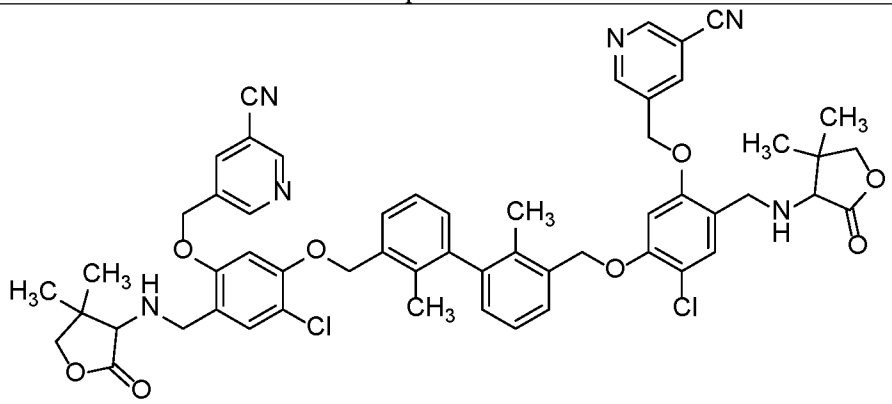
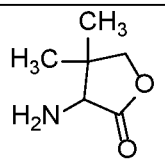
Compound 1019	
	
Starting Material	Intermediate 2
Agent Used	
MS	
MS (M + H)$^+$ Calcd.	953.3
MS (M + H)$^+$ Observ.	953.1
Retention Time	1.99 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

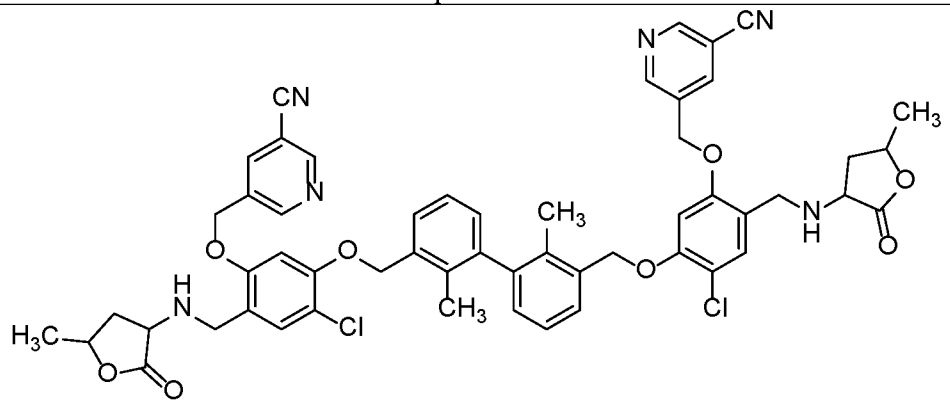
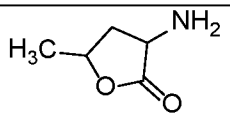
Compound 1020	
	
Starting Material	Intermediate 2
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	953.3
MS $(M + H)^+$ Observ.	953.4
Retention Time	3.37 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	20
Final % B	100
Gradient Time	4 min
Flow Rate	0.8 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 50x2, 3u

Compound 1021	
	
Starting Material	Intermediate 2
Agent Used	

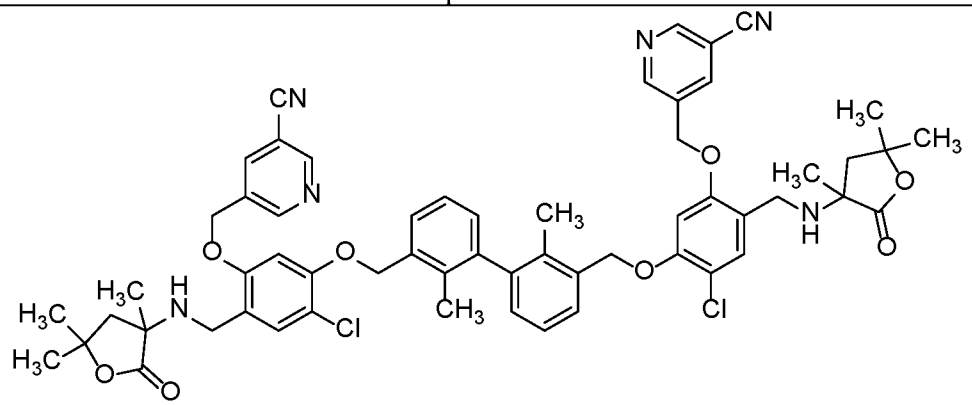
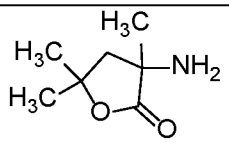
MS	
MS $(M + H)^+$ Calcd.	1009.3
MS $(M + H)^+$ Observ.	1009.5
Retention Time	3.68 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	20
Final % B	100
Gradient Time	4 min
Flow Rate	0.8 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 50x2, 3u

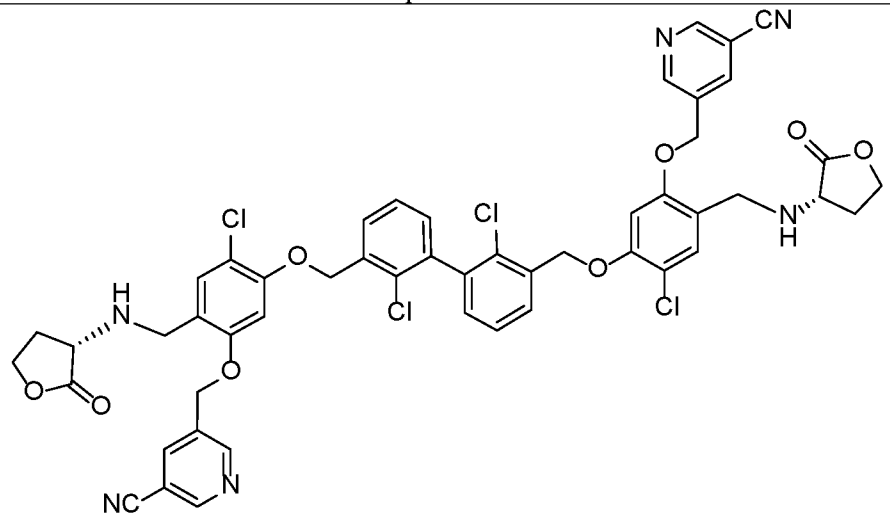
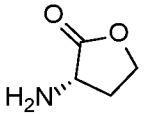
Compound 1022	
	
Starting Material	Intermediate 2
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	1009.3
MS $(M + H)^+$ Observ.	1009.5
Retention Time	3.25 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	20
Final % B	100
Gradient Time	4 min
Flow Rate	0.8 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 50x2, 3u

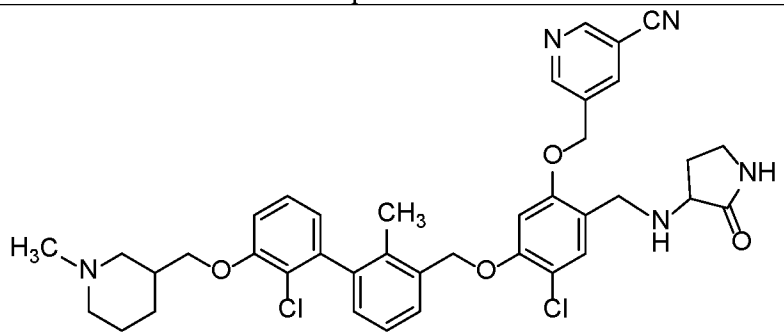
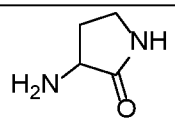
Compound 1023	
	
Starting Material	Intermediate 2
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	1009.3
MS $(M + H)^+$ Observ.	1009.2
Retention Time	2.71 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

Compound 1024	
	
Starting Material	Intermediate 2
Agent Used	

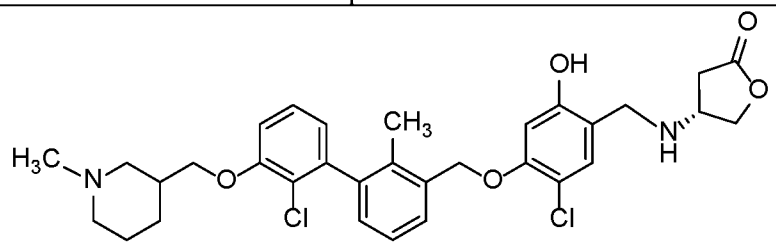
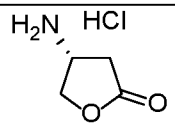
MS	
MS $(M + H)^+$ Calcd.	981.3
MS $(M + H)^+$ Observ.	981.2
Retention Time	3.71 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	20
Final % B	100
Gradient Time	4 min
Flow Rate	0.8 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 50x2, 3u

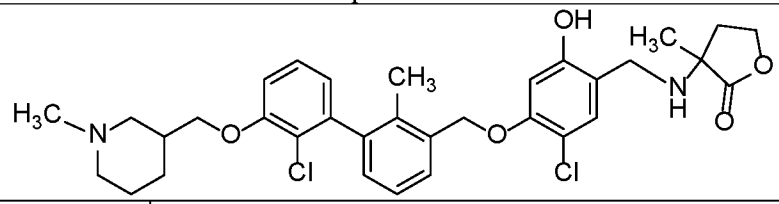
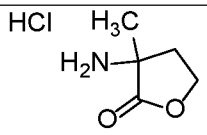
Compound 1025	
	
Starting Material	Intermediate 2
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	1937.4
MS $(M + H)^+$ Observ.	1937.2
Retention Time	4.11 min
LC Condition	
Solvent A	5 % ACN: 95% Water : 10mM Ammonium Actetate
Solvent B	95 % ACN: 5% Water : 10mM Ammonium Actetate
Start % B	20
Final % B	100
Gradient Time	4 min
Flow Rate	0.8 mL/min
Wavelength	220
Temperature	40 °C
Column	Phenomenex LUNA C18, 50x2, 3u

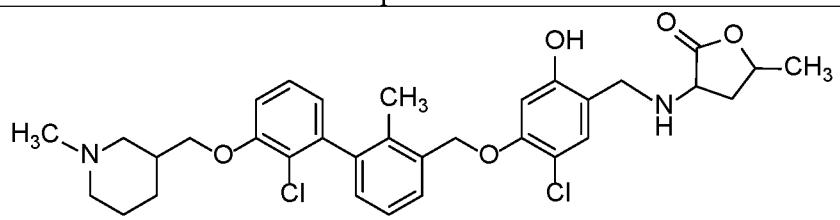
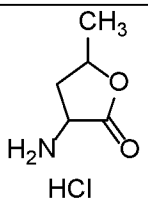
Compound 1026	
	
Starting Material	Intermediate 3
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	993.2
MS $(M + H)^+$ Observ.	993.1
Retention Time	1.67 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

Compound 1027	
	
Starting Material	Intermediate 1
Agent Used	

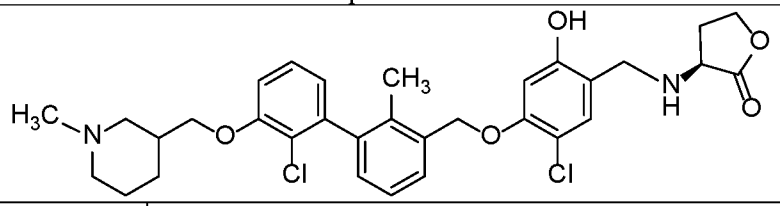
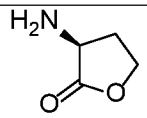
MS	
MS (M + H)$^+$ Calcd.	714.3
MS (M + H)$^+$ Observ.	714.2
Retention Time	1.37 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 µm particles

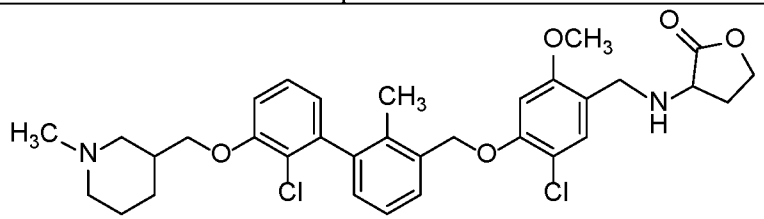
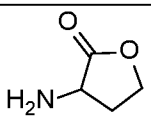
Compound 1028	
	
Starting Material	Intermediate 4
Agent Used	
MS	
MS (M + H)$^+$ Calcd.	599.2
MS (M + H)$^+$ Observ.	599.2
Retention Time	1.34 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 µm particles

Compound 1029	
	
Starting Material	Intermediate 4
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	613.2
MS $(M + H)^+$ Observ.	613.2
Retention Time	1.40 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

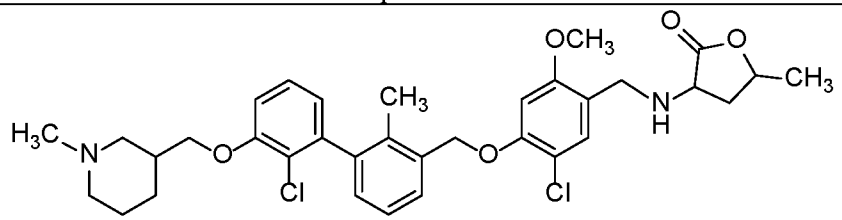
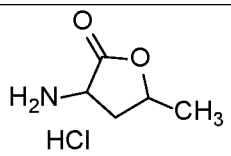
Compound 1030	
	
Starting Material	Intermediate 4
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	613.2
MS $(M + H)^+$ Observ.	613.2
Retention Time	1.40 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min

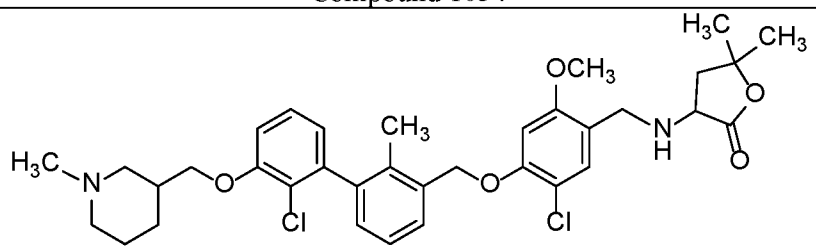
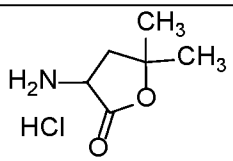
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 µm particles

Compound 1031	
	
Starting Material	Intermediate 4
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	599.2
MS $(M + H)^+$ Observ.	599.2
Retention Time	1.41 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 µm particles

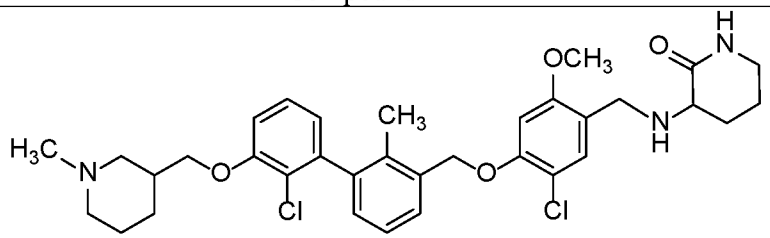
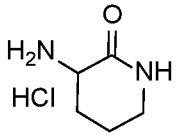
Compound 1032	
	
Starting Material	Intermediate 5
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	613.2
MS $(M + H)^+$ Observ.	613.1
Retention Time	1.41 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid

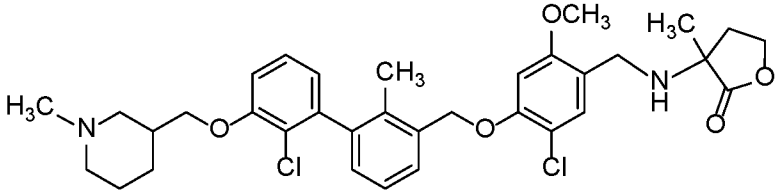
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 µm particles

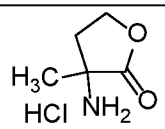
Compound 1033	
	
Starting Material	Intermediate 5
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	627.2
MS $(M + H)^+$ Observ.	627.2
Retention Time	1.45 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 µm particles

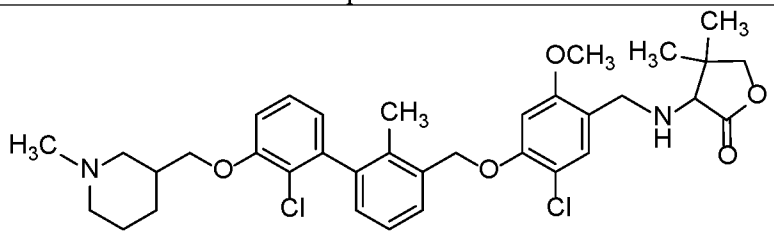
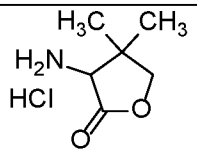
Compound 1034	
	
Starting Material	Intermediate 5
Agent Used	
MS	

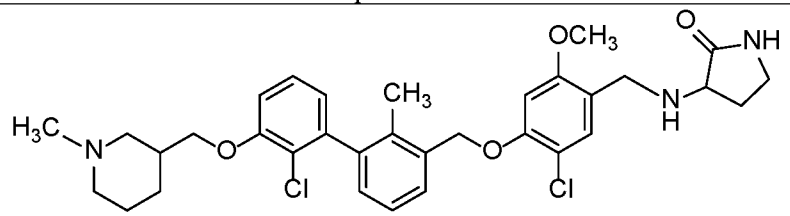
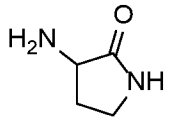
MS (M + H)$^+$ Calcd.	641.2
MS (M + H)$^+$ Observ.	641.2
Retention Time	1.49 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

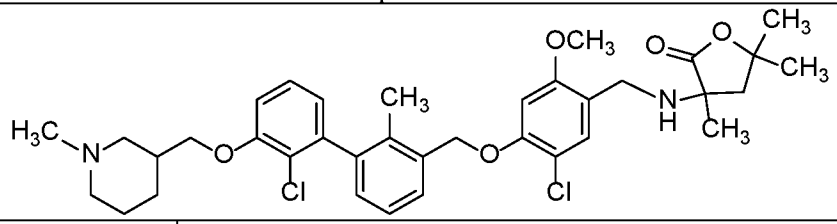
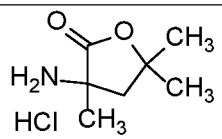
Compound 1035	
	
Starting Material	Intermediate 5
Agent Used	
MS	
MS (M + H)$^+$ Calcd.	626.2
MS (M + H)$^+$ Observ.	626.2
Retention Time	1.39 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

Compound 1036	
	
Starting Material	Intermediate 5

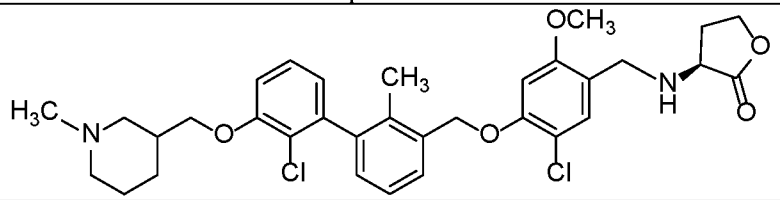
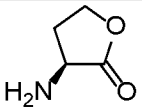
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	627.2
MS $(M + H)^+$ Observ.	627.2
Retention Time	1.42 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

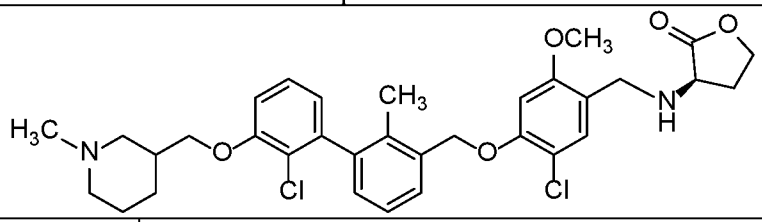
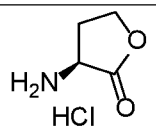
Compound 1037	
	
Starting Material	Intermediate 5
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	641.2
MS $(M + H)^+$ Observ.	641.2
Retention Time	1.49 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

Compound 1038	
	
Starting Material Agent Used	Intermediate 5 
MS	
MS $(M + H)^+$ Calcd.	612.2
MS $(M + H)^+$ Observ.	612.2
Retention Time	1.37 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

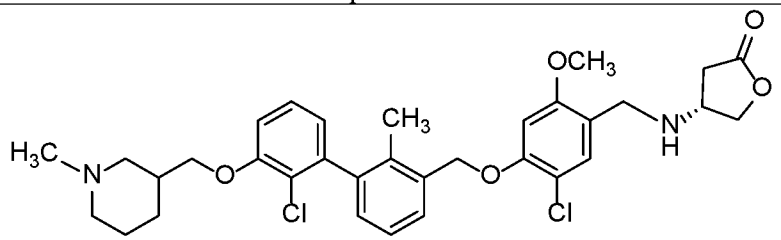
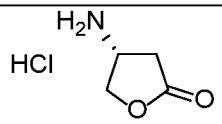
Compound 1039	
	
Starting Material Agent Used	Intermediate 5 
MS	
MS $(M + H)^+$ Calcd.	655.3
MS $(M + H)^+$ Observ.	655.2
Retention Time	1.51 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220

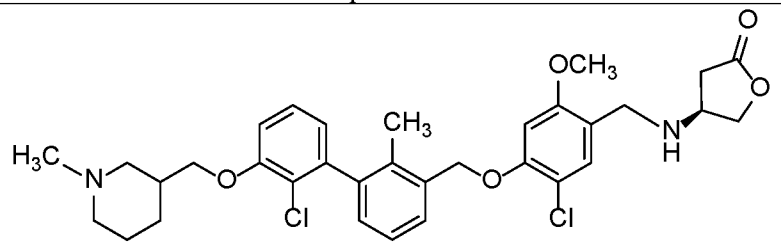
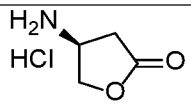
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

Compound 1040	
	
Starting Material	Intermediate 5
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	613.2
MS $(M + H)^+$ Observ.	613.1
Retention Time	1.45 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

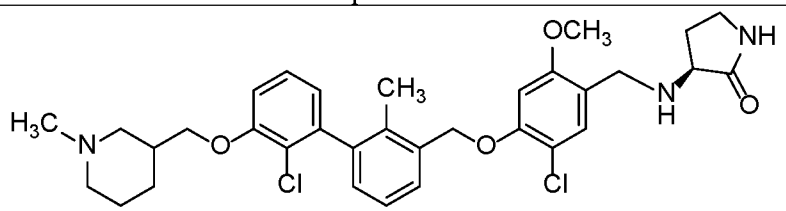
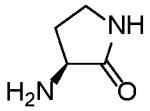
Compound 1041	
	
Starting Material	Intermediate 5
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	613.2
MS $(M + H)^+$ Observ.	613.2
Retention Time	1.41 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100

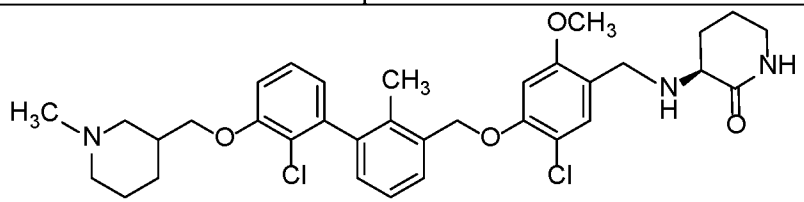
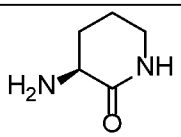
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

Compound 1042	
	
Starting Material	Intermediate 5
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	613.2
MS $(M + H)^+$ Observ.	613.2
Retention Time	1.40 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

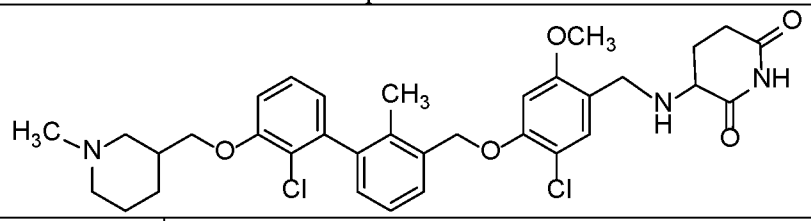
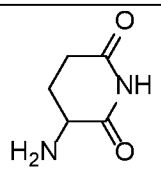
Compound 1043	
	
Starting Material	Intermediate 5
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	613.2
MS $(M + H)^+$ Observ.	613.1
Retention Time	1.40 min
LC Condition	

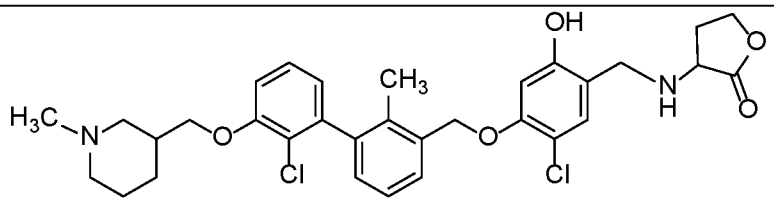
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

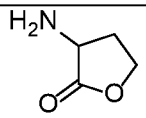
Compound 1044	
	
Starting Material	Intermediate 5
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	612.2
MS $(M + H)^+$ Observ.	612.2
Retention Time	1.39 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

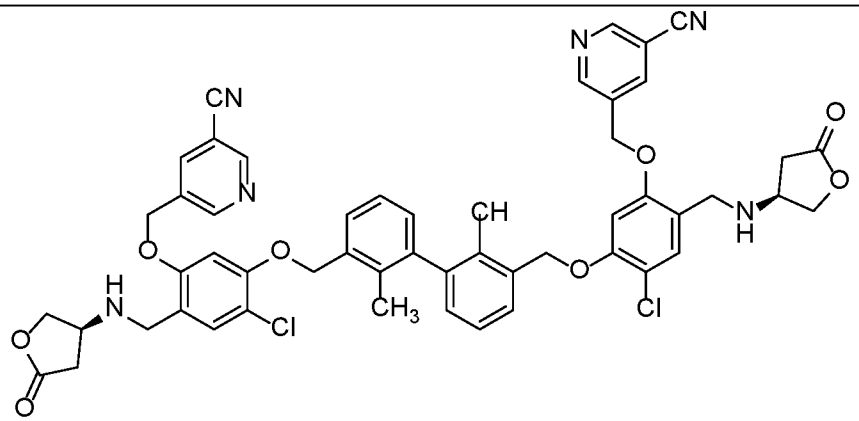
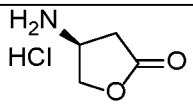
Compound 1045	
	
Starting Material	Intermediate 5
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	626.2

MS (M + H)$^+$ Observ.	626.2
Retention Time	1.45 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

Compound 1046	
	
Starting Material	Intermediate 5
Agent Used	
MS	
MS (M + H)$^+$ Calcd.	640.2
MS (M + H)$^+$ Observ.	640.2
Retention Time	1.39 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

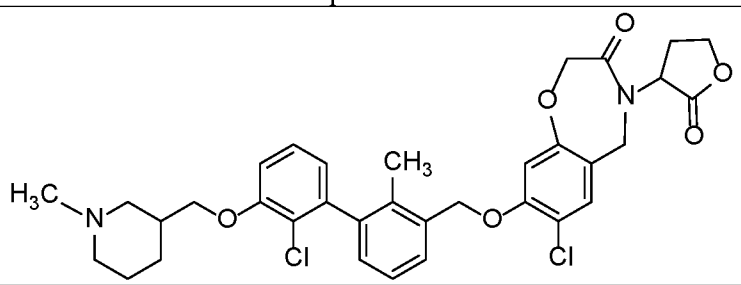
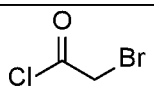
Intermediate 6	
	
Starting Material	Intermediate 4

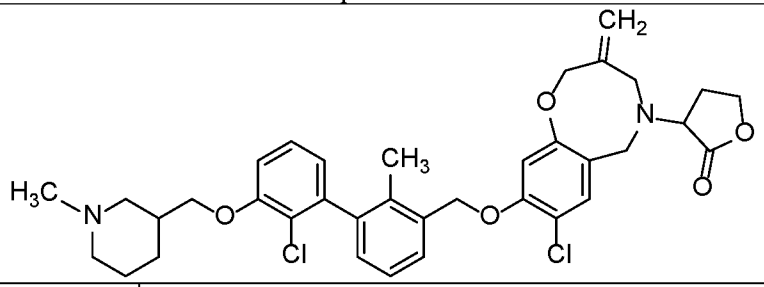
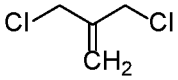
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	599.2
MS $(M + H)^+$ Observ.	599.2
Retention Time	1.09 min
LC Condition	
Solvent A	10% Acetonitrile/ 90% Water / 0.1% TFA
Solvent B	10% Water/ 90% Acetonitrile / 0.1% TFA
Start % B	0
Final % B	100
Gradient Time	1.5 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	40 °C
Column	Acquity BEH 21. X 50 mm 1.7um

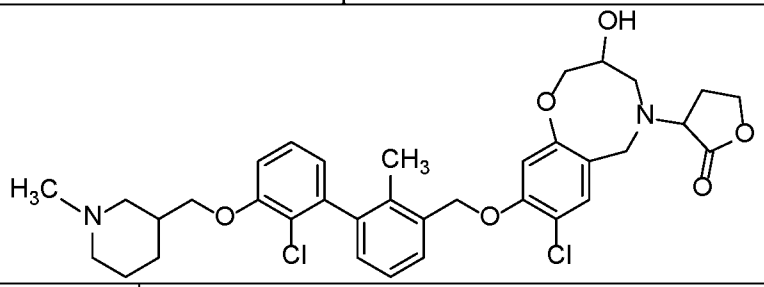
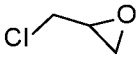
Intermediate 7	
	
Starting Material	Intermediate 2
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	953.3
MS $(M + H)^+$ Observ.	953.3
Retention Time	2.54 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Acquity BEH C18 2.1 x 50 mm; 1.7 um

General Procedure for the preparation of compounds of the present invention from Intermediate 6: A mixture of Intermediate 6 (1 eq.), an agent (1 eq.), iPr_2NEt (1 - 10 eq.) and Cs_2CO_3 or K_2CO_3 (1 – 20 eq.) in THF or dioxane or DME or their co-solvents was stirred at room temperature to 100 °C for 0.5 to 48 hours, before being quenched with methanol or water. After all the solvents were removed under vacuum, the residue was purified by the preparative HPLC to give a compound of the present invention.

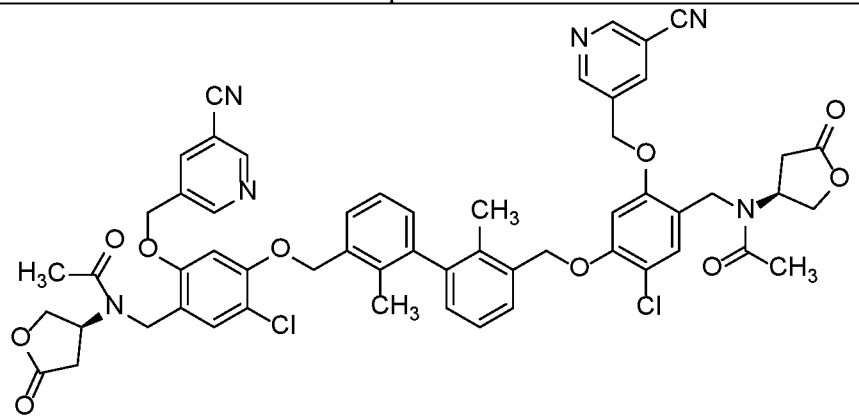
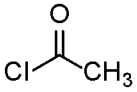
General Procedure for the preparation of compounds of the present invention from Intermediate 7: A mixture of Intermediate 7 (1 eq.) and an agent (1 - 20 eq.) in THF or dioxane or DME or their co-solvents, with or without iPr_2NEt or Et_3N (1 - 20 eq.) was stirred at room temperature to 100 °C for 0.5 to 48 hours, before being quenched with methanol or water. After all the solvents were removed under vacuum, the residue was purified by the preparative HPLC to give a compound of the present invention.

Compound 1047	
	
Starting Material	Intermediate 6
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	639.2
MS $(M + H)^+$ Observ.	639.2
Retention Time	1.75 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

Compound 1048	
	
Starting Material	Intermediate 6
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	651.2
MS $(M + H)^+$ Observ.	651.1
Retention Time	1.51 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 μm particles

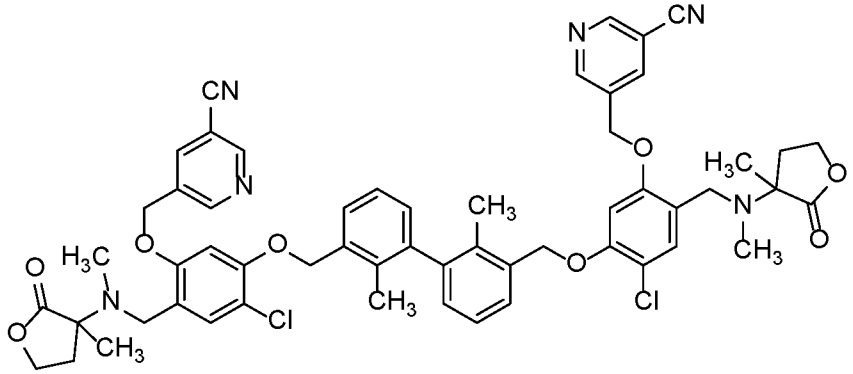
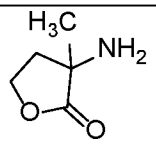
Compound 1049	
	
Starting Material	Intermediate 6
Agent Used	
MS	
MS $(M + H)^+$ Calcd.	655.2
MS $(M + H)^+$ Observ.	655.1
Retention Time	1.45 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min

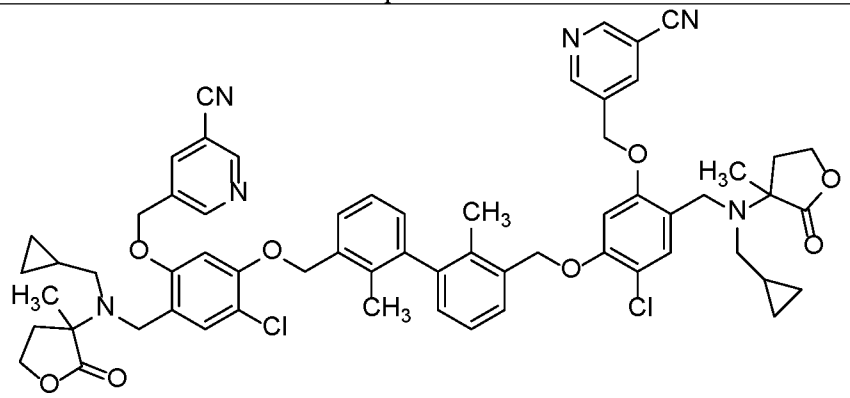
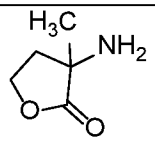
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 µm particles

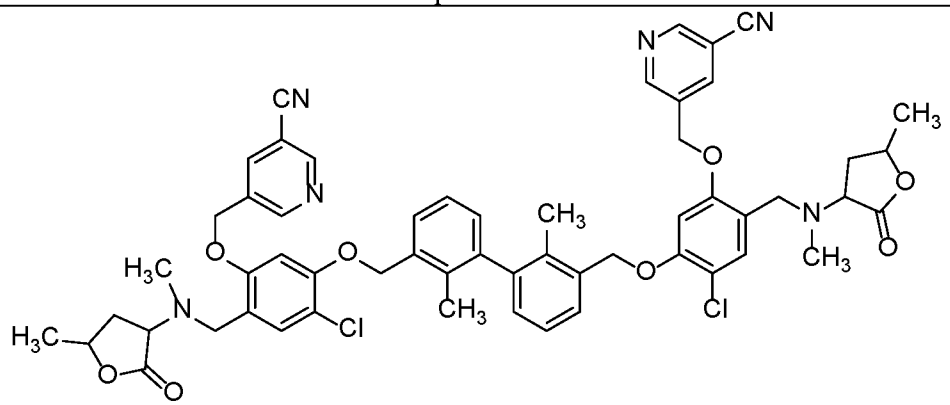
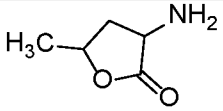
Compound 1050	
	
Starting Material	Intermediate 6
Agent Used	
MS	
MS (M - H)$^+$ Calcd.	1035.3
MS (M +-- H)$^+$ Observ.	1035.1
Retention Time	2.10 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Waters XBridge C18, 2.1 mm x 50 mm, 1.7 µm particles

General Procedure for the preparation of compounds of the present invention, from Reference Compounds 1 to 5 and amino amino lactones or lactams, in the presence of aldehyde or ketone: A mixture of any one of Reference Compounds 1 to 5 (1 eq.), an agent (1 - 20 eq.) in DCM or THF or dioxane or DME or MeOH or EtOH or their co-solvents, with or without iP2NEt, was stirred at room temperature for 0.5 to 48 hours, before AcOH (1 - 20 eq.) was added. The mixture was stirred at room temperature for 0.5 to 48 hours, then $NaCNBH_3$ (1 - 20 eq.) was added. The reaction was stirred at room temperature to 100^{O}C for 0.5 to 48 hours, before an aldehyde or ketone (1 - 20 eq.) was added. After be stirred at room temperature to 100 °C for 0.5 to 48 hours, the reaction

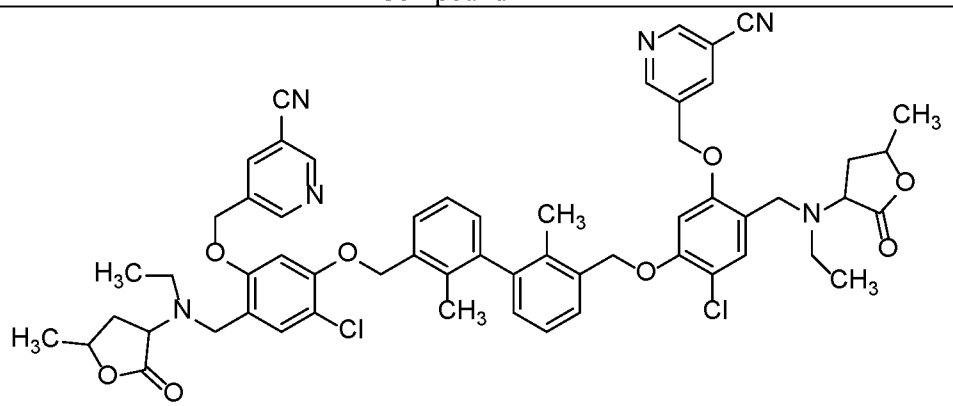
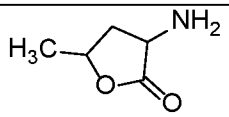
was quenched with methanol or water. After all the solvents were removed under vacuum, the residue was purified by the preparative HPLC to give a compound of the present invention.

Compound 1051	
	
Starting Material	Intermediate 2
Agent Used	
Aldehyde Used	formaldehyde
MS	
MS $(M + H)^+$ Calcd.	1009.3
MS $(M + H)^+$ Observ.	1009.3
Retention Time	2.72 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Acquity BEH C18 2.1 x 50 mm; 1.7 um

Compound 1052	
	
Starting Material	Intermediate 2
Agent Used	
Aldehyde Used	cyclopropanecarbaldehyde
MS	
MS $(M + H)^+$ Calcd.	1089.4
MS $(M + H)^+$ Observ.	1089.3
Retention Time	2.94 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Acquity BEH C18 2.1 x 50 mm; 1.7 um

Compound 1053	
	
Starting Material	Intermediate 2
Agent Used	

Aldehyde Used	formaldehyde
MS	
MS $(M + H)^+$ Calcd.	1009.3
MS $(M + H)^+$ Observ.	1009.3
Retention Time	2.56 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Acquity BEH C18 2.1 x 50 mm; 1.7 um

Compound 1054	
	
Starting Material	Intermediate 2
Agent Used	
Aldehyde Used	acetaldehyde
MS	
MS $(M + H)^+$ Calcd.	1037.4
MS $(M + H)^+$ Observ.	1037.3
Retention Time	2.68 min
LC Condition	
Solvent A	5:95 acetonitrile:water with 0.1 % trifluoroacetic acid
Solvent B	95:5 acetonitrile:water with 0.1 % trifluoroacetic acid
Start % B	0
Final % B	100
Gradient Time	3 min
Flow Rate	1 mL/min
Wavelength	220
Temperature	50 °C
Column	Acquity BEH C18 2.1 x 50 mm; 1.7 um

BIOLOGICAL ASSAYS

The ability of the compounds of the invention to bind to PD-L1 was investigated using a PD-1/PD-L1 Homogenous Time-Resolved Fluorescence (HTRF) binding assay.

The interaction of PD-1 and PD-L1 can be assessed using soluble, purified preparations of the extracellular domains of the two proteins. The PD-1 and PD-L1 protein extracellular domains were expressed as fusion proteins with detection tags, for PD-1, the tag was the Fc portion of Immunoglobulin (PD-1-Ig) and for PD-L1 it was the 6 histidine motif (PD-L1-His). All binding studies were performed in an HTRF assay buffer consisting of dPBS supplemented with 0.1% (with) bovine serum albumin and 0.05% (v/v) Tween-20. For the h/PD-L1-His binding assay, inhibitors were pre-incubated with PD-L1-His (10 nM final) for 15m in 4 µl of assay buffer, followed by addition of PD-1-Ig (20 nM final) in 1 µl of assay buffer and further incubation for 15m. HTRF detection was achieved using europium crypate-labeled anti-Ig (1 nM final) and allophycocyanin (APC) labeled anti-His (20 nM final). Antibodies were diluted in HTRF detection buffer and 5 µl was dispensed on top of the binding reaction. The reaction mixture was allowed to equilibrate for 30 minutes and the resulting signal (665nm/620nm ratio) was obtained using an EnVision fluorometer. Additional binding assays were established between the human proteins PD-1-Ig/PD-L2-His (20 & 5 nM, respectively) and CD80-His/PD-L1-Ig (100 & 10 nM, respectively).

Recombinant Proteins: Human PD-1 (25-167) with a C-terminal human Fc domain of immunoglobulin G (Ig) epitope tag [hPD-1 (25-167)-3S-IG] and human PD-L1 (18-239) with a C-terminal His epitope tag [hPD-L1(18-239)-TVMV-His] were expressed in HEK293T cells and purified sequentially by ProteinA affinity chromatography and size exclusion chromatography. Human PD-L2-His and CD80-His was obtained through commercial sources.

Methods

Homogenous Time-Resolved Fluorescence (HTRF) Assays of Binding of Soluble PD-1 to Soluble PD-L1. Soluble PD-1 and soluble PD-L1 refers to proteins with carboxyl-end truncations that remove the transmembrane-spanning regions and are fused to heterologous sequences, specifically the Fc portion of the human immunoglobuling G sequence (Ig) or the hexahistidine epitope tag (His). All binding studies were performed

in an HTRF assay buffer consisting of dPBS supplemented with 0.1% (w/v) bovine serum albumin and 0.05% (v/v) Tween-20. For the PD-1-Ig/PD-L1-His binding assay, inhibitors were pre-incubated with PD-L1-His (10 nM final) for 15m in 4 µl of assay buffer, followed by addition of PD-1-Ig (20 nM final) in 1 µl of assay buffer and further incubation for 15m. PD-L1 fusion proteins from either human, cynomologous macaques, mouse, or other species were used. HTRF detection was achieved using europium crypate-labeled anti-Ig monoclonal antibody (1 nM final) and allophycocyanin (APC) labeled anti-His monoclonal antibody (20 nM final). Antibodies were diluted in HTRF detection buffer and 5 µl was dispensed on top of binding reaction. The reaction was allowed to equilibrate for 30 minutes and signal (665nm/620nm ratio) was obtained using an EnVision fluorometer. Additional binding assays were established between PD-1-Ig/PD-L2-His (20 and 5 nM, respectively), CD80-His/PD-L1-Ig (100 and 10 nM, respectively) and CD80-His/CTLA4-Ig (10 and 5 nM, respectively).

Binding/competition studies between biotinylated Compound No. 71 and human PD-L1-His were performed as follows. The compounds of the present invention were pre-incubated with PD-L1-His (10 nM final) for 60 minutes in 4 µl of assay buffer followed by addition of biotinylated Compound No. 71 (0.5 nM final) in 1 µl of assay buffer. Binding was allowed to equilibrate for 30 minutes followed by addition of europium crypated labeled Streptavidin (2.5 pM final) and APC-labeled anti-His (20 nM final) in 5 µl of HTRF buffer. The reaction was allowed to equilibrate for 30m and signal (665nm/620nm ratio) was obtained using an EnVision fluorometer.

Recombinant Proteins. Carboxyl-truncated human PD-1 (amino acids 25-167) with a C-terminal human Ig epitope tag [hPD-1 (25-167)-3S-IG] and human PD-L1 (amino acids 18-239) with a C-terminal His epitope tag [hPD-L1(19-239)-tobacco vein mottling virus protease cleavage site (TVMV)-His] were expressed in HEK293T cells and purified sequentially by recombinant Protein A affinity chromatography and size exclusion chromatography. Human PD-L2-His (Sino Biologicals), CD80-His (Sino Biologicals), CTLA4-Ig (RnD Systems) were all obtained through commercial sources.

The table below lists the IC_{50} values for representative examples of this disclosure measured in the PD-1/PD-L1 Homogenous Time-Resolved Fluorescence (HTRF) binding assay.

Compound Number	HTRF IC_{50} (μM)
1001	0.0027
1002	0.0035
1003	0.0020
1004	0.0031
1005	0.0017
1006	0.0026
1007	0.0035
1008	0.0044
1009	0.0030
1010	0.0023
1011	0.0015
1012	0.0029
1013	0.0040
1014	0.0032
1015	0.0024
1016	0.1103
1017	0.1117
1018	0.0150
1019	0.0183
1020	0.0073
1021	0.1209
1022	0.1454
1023	>10
1024	0.0214
1025	>10
1026	0.0104
1027	0.0025
1028	0.0445
1029	0.1317
1030	0.0801
1031	0.0393
1032	0.0078
1033	0.0115
1034	0.0074
1035	0.0021
1036	0.0073
1037	0.1362
1038	0.0048
1039	0.0196
1040	0.0067
1041	0.0091
1042	0.0056
1043	0.0058
1044	0.0056

1045	0.0036
1046	0.0031
1047	0.3877
1048	3.8320
1049	0.0115
1050	0.0473
1051	0.3833
1052	2.5000
1053	1.4696
1054	2.5151

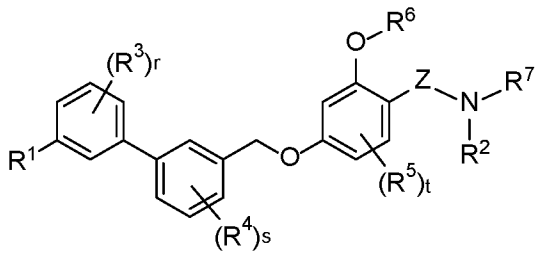
The compounds of the present invention tested possess activity as inhibitors of the PD-1/PD-L1 interaction, and therefore, may be used in the treatment of diseases or deficiencies associated with the PD-1/PD-L1 interaction. Via inhibition of the PD-1/PD-L1 interaction, the compounds of the present disclosure may be employed to treat infectious diseases such as HIV, septic shock, Hepatitis A, B, C, or D and cancer.

The foregoing description of the specific embodiments will so fully reveal the general nature of the invention that others can, by applying knowledge within the skill of the art, readily modify and/or adapt for various applications such specific embodiments, without undue experimentation, without departing from the general concept of the present invention. Therefore, such adaptations and modifications are intended to be within the meaning and range of equivalents of the disclosed embodiments, based on the teaching and guidance presented herein. It is to be understood that the phraseology or terminology herein is for the purpose of description and not of limitation, such that the terminology or phraseology of the present specification is to be interpreted by the skilled artisan in light of the teachings and guidance.

Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with a true scope and spirit of the invention being indicated by the following claims.

WE CLAIM:

1. A compound of Formula (I):



(I)

or a pharmaceutically acceptable salt thereof, wherein:

R^1 is independently $-(O)_m-(CH_2)_n-R^{1a}$ or $-(CH_2)_n-(O)_m-R^{1b}$;

R^{1a} is independently a 5- to 6-membered heterocycle with one to two heteroatoms selected from O, N, S, and NR^a; wherein said heterocycle is substituted with 0 to 3 R^b;

R^{1b} is phenyl or a 5- to 6-membered heteroaryl with one to four heteroatoms selected from O, N, S, and NR^a; wherein said phenyl and heteroaryl are substituted with 0 to 3 R^{1c};

R^{1c} is independently halogen, CN, OH, SH, NH_2, C_1-C_4 haloalkyl, C_1-C_4 alkoxy, C_1-C_4 haloalkoxy, C_1-C_4 alkyl substituted with 0 to 1 OH, or C_3-C_6 cycloalkyl, $-(O)_m-(CH_2)_n-R^{1d}$, or $-(CH_2)_n-NR^7-R^{2a}$;

R^{1d} is phenyl or a 5- to 6-membered heteroaryl with one to four heteroatoms selected from O, N, S, and NR^a; wherein said phenyl and heteroaryl are substituted with 0 to 3 R^d;

Z is a bond or a C_1-C_2 alkylene;

R^2 is independently a 4- to 8-membered lactone or lactam substituted with 0 to 4 R^c;

R^3, R^4 and R^5 are, at each occurrence, independently halogen, CN, OH, SH, NH_2, C_1-C_4 alkyl, C_1-C_4 haloalkyl, C_1-C_4 alkoxy, C_1-C_4 haloalkoxy, or C_3-C_6 cycloalkyl;

R^6 is independently hydrogen, C_1-C_4 alkyl, or $-(CH_2)_n-R^{6a}$;

R^{6a} is independently phenyl or a 5- to 6-membered heteroaryl with one to four heteroatoms selected from O, N, S, and NR^a; wherein said phenyl and heteroaryl are substituted with 0 to 3 R^{6b};

R^{6b} is independently halogen, CN, OH, C_1-C_4 alkyl, C_1-C_4 haloalkyl, C_1-C_4 alkoxy, or C_1-C_4 haloalkoxy;

R^7 is independently hydrogen, C_1-C_4 alkyl, $-C(O)C_1$-C_4 alkyl, $-(CH_2)_n-C_3$-C_6 cycloalkyl, or $-(CH_2)_n$-phenyl;

alternatively, R^6 and R^7 can be joined to form W; and

W is a 1 to 4 membered linker with elements independently selected from carbon, oxygen, and nitrogen; wherein said linker is substituted with 0 to 2 R^e;

R^a is independently halogen, C_1-C_4 alkyl, -$(CH_2)_n$-C_3-C_6 cycloalkyl, or -$(CH_2)_n$-phenyl;

R^b and R^c are, at each occurrence, independently oxo, halogen, CN, OH, C_1-C_4 alkyl, or C_1-C_4 alkoxy;

R^d is, at each occurrence, independently halogen, CN, OH, C_1-C_4 alkyl, or C_1-C_4 alkoxy;

R^e is independently oxo, $=CH_2$, halogen, CN, OH, C_1-C_4 alkyl, or C_1-C_4 alkoxy;

m is, at each occurrence, independently 0 or 1;

n is, at each occurrence, independently 0, 1, or 2;

r, s, and t are each independently 0, 1, or 2.

2. The compound of claim 1, wherein:

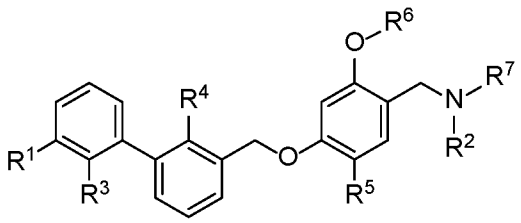
R^2 is independently a 5- to 6-membered lactone or lactam substituted with 0 to 4 R^a;

R^a is independently oxo, halogen, OH, or C_1-C_3 alkyl;

W is a 2 to 3 membered linker with elements independently selected from carbon, oxygen, and nitrogen; wherein said linker is substituted with 0 to 2 R^e; and

R^e is independently oxo, $=CH_2$, OH, or C_1-C_4 alkyl.

3. The compound of claim 1 or claim 2, wherein the compound is of Formula (II):



(II)

or a pharmaceutically acceptable salt thereof, wherein:

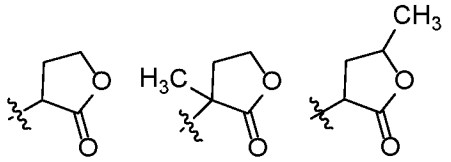
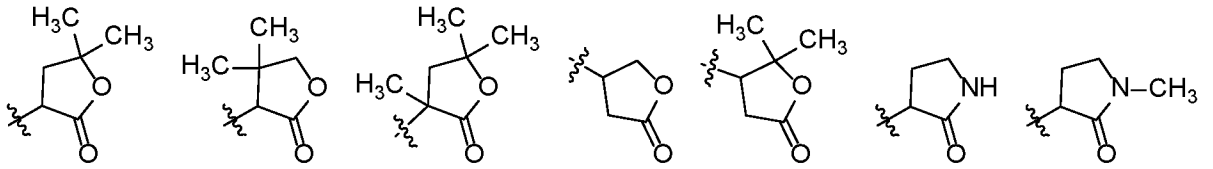
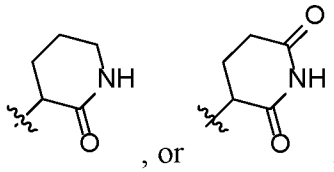
R^1 is independently -O-CH_2-R^{1a} or -CH_2-O-R^{1b};

R^{1a} is N-(C_1-C_3 alkyl)-piperidinyl;

R^{1b} is phenyl substituted with 1 to 3 R^{1c};

R^{1c} is independently halogen, -CH_2OH, -O-CH_2-R^{1d}, or -CH_2-NR^7-R^{2a};

R^{1d} is cyano-substituted pyridyl;

R^2 and R^{2a} are, at each occurrence, independently  ,  ,  , or ;

R^3 is independently hydrogen, C_1-C_3 alkyl or halogen;

R^4 is independently hydrogen, C_1-C_3 alkyl or halogen;

R^5 is independently hydrogen, C_1-C_3 alkyl or halogen;

R^6 is independently hydrogen, C_1-C_3 alkyl, or -CH_2-(cyano-substituted pyridyl); and

R^7 is independently hydrogen, C_1-C_3 alkyl, -C(O)C_1-C_3 alkyl or -CH_2-cyclopropyl.

4. The compound of claim 3, wherein:

R^1 is -O-CH_2-R^{1a};

R^{1a} is N-(C_1-C_3 alkyl)-piperidinyl;

R^6 is -CH_2-(cyano-substituted pyridyl); and

R^7 is hydrogen.

5. The compound of claim 3, wherein:

R^1 is -CH_2-O-R^{1b};

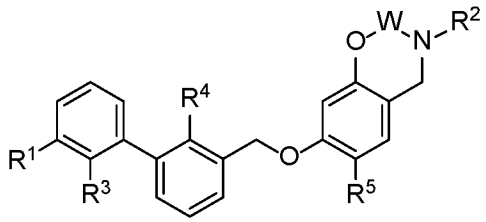
R^{1b} is phenyl substituted with 1 to 3 R^{1c};

R^{1c} is independently halogen, -O-CH_2-R^{1d}, or -CH_2-NR^7-R^{2a};

R^{1d} is cyano-substituted pyridyl; and

R^7 is hydrogen.

6. The compound of claim 1 or claim 2, wherein the compound is of Formula (III):



(III)

or a pharmaceutically acceptable salt thereof, wherein:

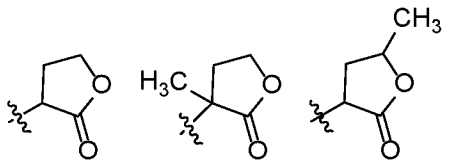
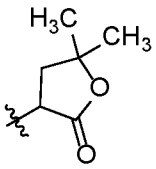
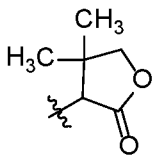
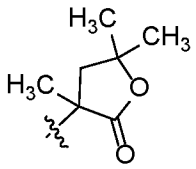
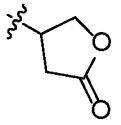
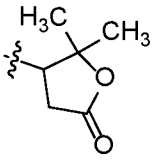
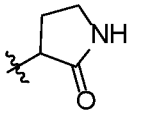
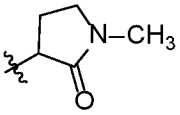
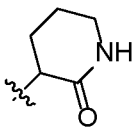
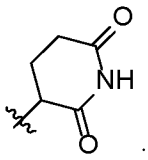
R^1 is independently -O-CH_2-R^{1a} or -CH_2-O-R^{1b};

R^{1a} is N-(C_1-C_3 alkyl)-piperidinyl;

R^{1b} is phenyl substituted with 1 to 3 R^{1c};

R^{1c} is independently halogen, -O-CH_2-R^{1d}, or -CH_2-NR^7-R^{2a};

R^{1d} is cyano-substituted pyridyl;

R^2 and R^{2a} are, at each occurrence, independently  , , ,  ,  ,  ,  ,  ,  ,  ,  ,  , or ;

R^3 is independently hydrogen, C_1-C_3 alkyl or halogen;

R^4 is independently hydrogen, C_1-C_3 alkyl or halogen;

R^5 is independently hydrogen, C_1-C_3 alkyl or halogen; and

W is independently -$CH_2C(O)$-, -$CH_2C(=CH_2)CH_2$-, or -$CH_2C(OH)CH_2$-.

7. A compound of claim 1, wherein the compound is selected from the exemplified Examples, Compound 1001 to 1054, or a pharmaceutically acceptable salt thereof.

8. A pharmaceutical composition comprising a compound of any of claims 1 through 7, or a pharmaceutically acceptable salt thereof, and a pharmaceutically acceptable carrier.

9. A compound or a pharmaceutically acceptable salt thereof according to any of claims 1 through 7, or a pharmaceutical composition according to claim 8, for use as a medicament.

10. A compound or a pharmaceutically acceptable salt thereof according to any of claims 1 through 7, or a pharmaceutical composition according to claim 8, for use in the manufacture of a medicament for treatment of cancer in a subject in need thereof.

11. A compound or a pharmaceutically acceptable salt thereof according to any of claims 1 through 7, for use in enhancing, stimulating, modulating and/or increasing an immune response in a subject in need thereof, comprising administering to the subject a therapeutically effective amount of said compound or a pharmaceutically acceptable salt thereof.

12. A compound or a pharmaceutically acceptable salt thereof according to any of claims 1 through 7, for use in inhibiting growth, proliferation, or metastasis of cancer cells in a subject in need thereof, comprising administering to the subject a therapeutically effective amount of said compound or a pharmaceutically acceptable salt thereof.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2022/027615

A. CLASSIFICATION OF SUBJECT MATTER
INV. C07D403/12 C07D403/14 C07D407/12 C07D407/14 A61K31/44
A61K31/445 A61P35/00 C07D413/14
ADD.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
C07D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, CHEM ABS Data, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 3 658 522 A1 (CHEMOCENTRYX INC [US]) 3 June 2020 (2020-06-03) claims; examples	1-12
A	WO 2020/047035 A1 (CHEMOCENTRYX INC [US]) 5 March 2020 (2020-03-05) claims; examples	1-12
A	WO 2015/034820 A1 (SQUIBB BRISTOL MYERS CO [US]) 12 March 2015 (2015-03-12) claims; examples	1-12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 August 2022	10/08/2022

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Beyss-Kahana, Ellen

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2022/027615

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