



(43) International Publication Date
6 February 2014 (06.02.2014)

(10) International Publication Number
WO 2014/022010 A3

- (51) International Patent Classification:
C07C 1/00 (2006.01) *C08F 4/52* (2006.01)
- (21) International Application Number:
PCT/US2013/046569
- (22) International Filing Date:
19 June 2013 (19.06.2013)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
61/679,505 3 August 2012 (03.08.2012) US
- (71) Applicants: **EXXONMOBIL CHEMICAL PATENTS INC.** [US/US]; 5200 Bayway Dr., Baytown, Texas 77200 (US). **RAMOT AT TEL-AVIV UNIVERSITY LTD.** [IL/IL]; P.O. Box 39296, 61392 Tel Aviv (IL).
- (72) Inventors: **GIESBRECHT, Garth R.**; 66 North Emory Bend Place, The Woodlands, Texas 77381 (US). **HOLT-CAMP, Matthew W.**; 26935 Carol Dr., Huffinam, Texas 77336 (US). **KOL, Moshe**; 12 HaAluf Nechemia Tamari St., 52377 Ramat Gan (IL). **DAY, Gregory S.**; 3402 Preston Ave. Apt. 826, Pasadena, Texas 77505 (US). **CANO, David A.**; 3322 Candleway Dr., Spring, Texas 77338 (US).
- (74) Agent: **LUNDEEN, Daniel N.**; 2710 Louisiana St., Houston, Texas 77006 (US).
- (81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

- (88) Date of publication of the international search report:
21 August 2014



WO 2014/022010 A3

(54) Title: NON-SYMMETRIC CATALYSTS COMPRISING SALAN LIGANDS

(57) Abstract: Catalysts comprising a non-symmetrical Salan ligand with a carbazole moiety. Also disclosed are catalyst systems comprising the catalyst and an activator; methods to prepare the ligands, catalysts and catalyst systems; processes to polymerize olefins using the catalysts and/or catalyst systems; and the olefin polymers prepared according to the processes.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 13/46569

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - C09B 55/00; C07C 1/00 (2013.01)

USPC - 556/33; 556/34;585/329; 585/502

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)

USPC: 556/33; 556/34;585/329; 585/502

IPC: C09B 55/00; C07C 1/00 (2013.01)

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

See Search Words Below

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PATBASE: PGPB, USPT, USOC, EPAB, JPAB

Google: Scholar/Patents: NONSYMMETRIC CATALYSTS SALAN LIGANDS olefin polymerization metal Hf Ti Zr metal catalyst carbazole propylene activator borate alumoxane ethylene bridge phenyl *anilinium polypropylene adamantyl

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2011/158241 A1 (KOL et al.) 22 December 2011 (22.12.2011) pg 11, ln 4-21; pg 13,ln 24-29; pg 24, ln 9-10;pg 26, ln 10-12; pg 23, ln 19-20;pg 26, ln 13-26; pg 75,ln 7-14	1-27
Y	WO2012/004680 A2 (ROBERT et al.) 12 January 2012 (12.01.2012) para [0056];[0057];[0072];[0073]	1-27
Y	COHEN et al. Ligand, Different Metals: Diiodo-Salan Complexes of the Group 4 Triad in Isospecific Polymerization of 1-Hexene and Propylene in Macromolecules, 2010, Vol 43, pp 1689-1691. pg 1689, Scheme 1	1-27
Y	US 5,153,157 A (HLATKY et al.) 6 October, 1992 (06.10.1992) Col 8, ln 42-67; Col 7, ln 50-63; Col 9,ln 65-68; Col 9,ln 33-37; Col 9,ln 46-48; Col 10, ln 1-40	20-22

 Further documents are listed in the continuation of Box C.

* 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

25 October 2013 (25.10.2013)

Date of mailing of the international search report

13 JUN 2014

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-3201

Authorized officer:

Lee W. Young

PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774