

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
8 January 2004 (08.01.2004)

PCT

(10) International Publication Number
WO 2004/003032 A3

(51) International Patent Classification⁷: **C08F 210/02**,
4/642, C07F 5/00

(21) International Application Number:
PCT/US2003/020320

(22) International Filing Date: 26 June 2003 (26.06.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/186,361 28 June 2002 (28.06.2002) US

(71) Applicant: **UNIVATION TECHNOLOGIES** [US/US];
Kevin M. Faulkner, 5555 San Felipe, Suite 1950, Houston,
TX 77056 (US).

(72) Inventors: **HOLTCAMP, Matthew, W.**; 26935 Carol
Drive, Huffman, TX 77336 (US). **CANO, David, A.**; 3322
Candleway Drive, Spring, TX 77388 (US).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,

CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD,
SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ,
VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

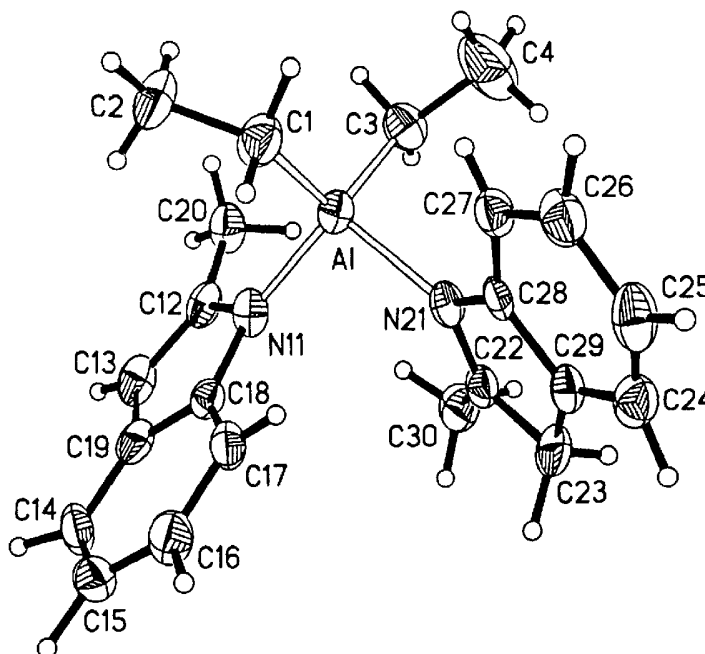
Published:

- with international search report
- before the expiration of the time limit for amending the
claims and to be republished in the event of receipt of
amendments

(88) Date of publication of the international search report:
29 July 2004

[Continued on next page]

(54) Title: HETEROCYCLIC NITROGEN-CONTAINING ACTIVATORS AND CATALYST SYSTEMS FOR OLEFIN POLYMERIZATION



(57) Abstract: An aluminum activator and catalyst system for olefin polymerization is provided. In one aspect, the catalyst system comprises a polymerization catalyst and an activator comprising two or more heterocyclic nitrogen-containing ligands coordinated to a Group 13 atom. Preferably, the activator is a reaction product of one or more Group 13 atom-containing compounds and one or more heterocyclic nitrogen-containing compounds.



For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 03/20320

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C08F210/02 C08F4/642 C07F5/00

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)

IPC 7 C08F C07F

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 practical, search terms used)

EPO-Internal, CHEM ABS Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99/42467 A (DOW CHEMICAL CO) 26 August 1999 (1999-08-26) claims 8-11; example 4; table 1 -----	1,6, 10-13, 18, 22-24, 27,29
A	WO 00/29454 A (UNIVATION TECH LLC) 25 May 2000 (2000-05-25) cited in the application page 16 - page 22 -----	1-31
A	WO 99/64476 A (UNIVATION TECH LLC) 16 December 1999 (1999-12-16) page 21 - page 28 ----- -/--	1-31

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in 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 document 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

20 November 2003

Date of mailing of the international search report

19.05.2004

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Parry, J

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 03/20320

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DATABASE CA [Online] CHEMICAL ABSTRACTS SERVICE, COLUMBUS, OHIO, US; ZHENG, RONGHUI ET AL: "Modification effect of electron donors on supported catalyst for propylene polymerization" XP002254906 retrieved from STN Database accession no. 108:38485 abstract & SHIYOU HUAGONG (1987), 16(10), 686-91, -----	1-31
E	WO 03/064433 A (UNIVATION TECHNOLOGIES, LLC, USA) 7 August 2003 (2003-08-07) claim 8; examples 1-11; tables 1-2B -----	1-31

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 03/20320

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-31 (in part)

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: claims 1-31 (in part)

The subject matter of claims 1-31 (in part) insofar as the heterocyclic compound is a substituted or unsubstituted pyrrole.

2. claims: claims 1-31 (in part)

The subject matter of claims 1-31 (in part) insofar as the heterocyclic compound is a substituted or unsubstituted imidazole.

3. claims: claims 1-31 (in part)

The subject matter of claims 1-31 (in part) insofar as the heterocyclic compound is a substituted or unsubstituted pyrazole.

4. claims: claims 1-31 (in part)

The subject matter of claims 1-31 (in part) insofar as the heterocyclic compound is a substituted or unsubstituted pyrroline.

5. claims: claims 1-31 (in part)

The subject matter of claims 1-31 (in part) insofar as the heterocyclic compound is a substituted or unsubstituted pyrrolidine.

6. claims: claims 1-31 (in part)

The subject matter of claims 1-31 (in part) insofar as the heterocyclic compound is a substituted or unsubstituted purine.

7. claims: claims 1-31 (in part)

The subject matter of claims 1-31 (in part) insofar as the heterocyclic compound is a substituted or unsubstituted carbazole.

8. claims: claims 1-31 (in part)

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

The subject matter of claims 1-31 (in part) insofar as the heterocyclic compound is a substituted or unsubstituted indole.

9. claims: claims 1-31 (in part)

The subject matter of claims 1-31 (in part) insofar as the heterocyclic compound is other than that mentioned in any of groups 1-8.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 03/20320

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9942467	A	26-08-1999	AT 243700 T	15-07-2003
			AU 749065 B2	20-06-2002
			AU 3298099 A	06-09-1999
			BR 9908336 A	10-10-2000
			CA 2317774 A1	26-08-1999
			CN 1120168 B	03-09-2003
			DE 69909057 D1	31-07-2003
			DE 69909057 T2	06-05-2004
			EP 1056752 A1	06-12-2000
			ES 2196835 T3	16-12-2003
			HU 0100783 A2	28-06-2001
			ID 25653 A	19-10-2000
			JP 2002504485 T	12-02-2002
			NO 20004135 A	18-10-2000
			PL 342450 A1	04-06-2001
			TR 200002404 T2	22-01-2001
			US 2002132729 A1	19-09-2002
			WO 9942467 A1	26-08-1999
			US 6716786 B1	06-04-2004
			US 2001027161 A1	04-10-2001
			ZA 9901355 A	21-08-2000
-----			-----	
WO 0029454	A	25-05-2000	US 6147173 A	14-11-2000
			AT 247676 T	15-09-2003
			AU 756439 B2	16-01-2003
			AU 1809000 A	05-06-2000
			BR 9915237 A	24-07-2001
			CA 2330882 A1	05-05-2000
			DE 69910611 D1	25-09-2003
			DE 69910611 T2	25-03-2004
			EP 1135419 A1	26-09-2001
			JP 2002530442 T	17-09-2002
			PT 1135419 T	30-01-2004
			WO 0029454 A1	25-05-2000
			US 6211105 B1	03-04-2001
-----			-----	
WO 9964476	A	16-12-1999	AU 743376 B2	24-01-2002
			AU 4333399 A	30-12-1999
			BR 9911158 A	03-04-2001
			CA 2330529 A1	16-12-1999
			EP 1090045 A1	11-04-2001
			JP 2002517571 T	18-06-2002
			WO 9964476 A1	16-12-1999
			US 6211312 B1	03-04-2001
-----			-----	
WO 0364433	A	07-08-2003	WO 03064433 A1	07-08-2003
-----			-----	