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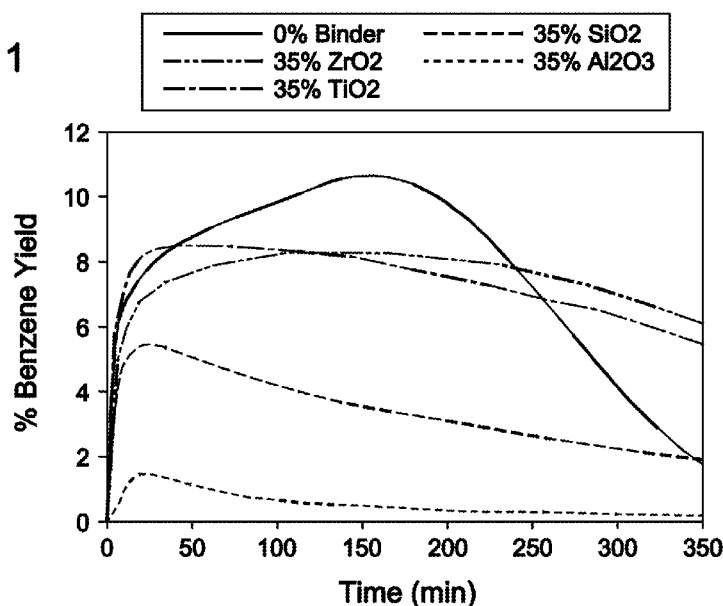
Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

[Continued on next page]

(54) Title: PRODUCTION OF AROMATICS FROM METHANE

Fig. 1



(57) Abstract: A catalyst for the conversion of methane to higher hydrocarbons including aromatic hydrocarbons comprises a support and molybdenum or a compound thereof dispersed on the support. The support comprises an aluminosilicate zeolite combined with a binder selected from silica, titania, zirconia and mixtures thereof. The catalyst is substantially free of aluminum external to the framework of the aluminosilicate zeolite.



- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))* — *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))*

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INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER

INV. B01J29/48 C07C2/76 C10G50/00

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)

B01J C07C C10G

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, COMPENDEX, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 905 051 A (WU AN-HSIANG [US] ET AL) 18 May 1999 (1999-05-18) example 1	1-7
X	WO 2005/032713 A (UOP LLC [US]; SHARMA SANJAY B [US]; KULACH JOHN E [US]; IMRIE AARON J) 14 April 2005 (2005-04-14) abstract paragraphs [0004], [0007], [0009], [0010], [0013], [0034] - [0038], [0040] - [0044]	1-7
Y	paragraphs [0017], [0023], [0030] claims 1,5	1-13
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☒ 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 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

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& document member of the same patent family

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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2006/006480 A (SUED CHEMIE CATALYSTS JAPAN IN [JP]; ICHIKAWA MASARU [JP]; KOJIMA RYOI) 19 January 2006 (2006-01-19) abstract examples 1,5	1-13
Y	WO 2007/123808 A (EXXONMOBIL CHEM PATENTS INC [US]; IACCINO LARRY L [US]; SANGAR NEERAJ) 1 November 2007 (2007-11-01) abstract paragraphs [0031], [0052], [0063], [0069], [0072], [0076], [0078] examples 1,2	1-13
Y	US 5 430 000 A (TIMKEN HYE K C [US]) 4 July 1995 (1995-07-04) abstract examples 1-15 tables 1-3 claims 1,3-6,16	1-13
Y	US 5 182 242 A (MARLER DAVID O [US]) 26 January 1993 (1993-01-26) abstract column 3, line 34 - line 49 examples 1-10 claims 1-4,14-22	1-13
P,X	HONDA K ET AL: "Preparation of highly active binder-added MoO ₃ /HZSM-5 catalyst for the non-oxidative dehydroaromatization of methane" APPLIED CATALYSIS A: GENERAL 20081215 ELSEVIER NL, vol. 351, no. 1, 15 December 2008 (2008-12-15), pages 122-130, XP002524039 abstract paragraphs [02.1], [2.1.1], [0002], [0002] table 1 figures 4,6,8	1-13
P,X	WO 2008/062028 A (BASF SE [DE]; MUELLER ULRICH [DE]; FREIBERGER HARALD [DE]) 29 May 2008 (2008-05-29) abstract page 6, line 40 - page 7, line 14 examples 1,3 page 8, line 14 - line 17	1-13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2008/087980

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 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 No. III Observations where unity of invention is lacking (Continuation of item 3 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 fees, this Authority did not invite payment of additional fees.
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 - 13

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ 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: 1-13

Catalyst comprising a zeolite, molybdenum, and an aluminum-free binder. Process to convert methane to aromatics using that catalyst.

2. claims: 14-15

Process to convert methane to aromatics using a catalyst comprising molybdenum supported on particles having a certain size and density

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2008/087980

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5905051	A	18-05-1999	NONE	
WO 2005032713	A	14-04-2005	AU 2003278771 A1	21-04-2005
WO 2006006480	A	19-01-2006	JP 2006043686 A	16-02-2006
WO 2007123808	A	01-11-2007	AR 060582 A1	25-06-2008
			AU 2007241001 A1	01-11-2007
			CN 101460429 A	17-06-2009
			US 2007293709 A1	20-12-2007
US 5430000	A	04-07-1995	US 5352644 A	04-10-1994
US 5182242	A	26-01-1993	AU 660555 B2	29-06-1995
			AU 4398693 A	30-12-1993
			CA 2125656 A1	09-12-1993
			EP 0644801 A1	29-03-1995
			JP 7507485 T	24-08-1995
			WO 9324226 A1	09-12-1993
WO 2008062028	A	29-05-2008	EP 2094627 A2	02-09-2009