



- (51) **International Patent Classification:**
C07C 51/15 (2006.01) *C07C 57/04* (2006.01)
- (21) **International Application Number:**
PCT/US2016/066360
- (22) **International Filing Date:**
13 December 2016 (13.12.2016)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
62/267,601 15 December 2015 (15.12.2015) US
- (71) **Applicant:** CHEVRON PHILLIPS CHEMICAL COMPANY LP [US/US]; 10001 Six Pines Drive, The Woodlands, Texas 77380 (US).
- (72) **Inventors:** IACONO, Pasquale; 2011 Nova Avenue, Apt. 1, Bartlesville, Oklahoma 74006 (US). HLAVINKA, Mark L.; 2717 S. Florence Drive, Tulsa, Oklahoma 74114 (US).
- (74) **Agents:** WIGLEY, David E. et al.; Sutherland Asbill & Brennan LLP, 999 Peachtree Street, NE, Atlanta, Georgia 30309-3996 (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, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, 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, SA, 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, ST, 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).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

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:

24 August 2017

(54) **Title:** FORMATION OF α,β -UNSATURATED CARBOXYLIC ACIDS AND SALTS THEREOF FROM METALALACTONES AND ANIONIC POLYELECTROLYTES

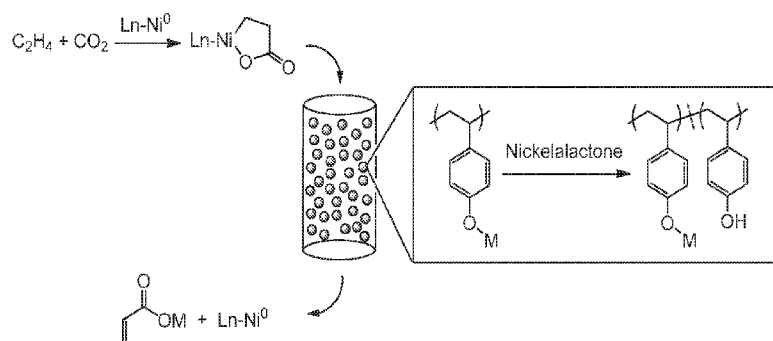


FIG. 1

(57) **Abstract:** This disclosure provides for routes of synthesis of acrylic acid and other α,β -unsaturated carboxylic acids and their salts, including catalytic methods. For example, there is provided a process for producing an α,β -unsaturated carboxylic acid or a salt thereof, the process comprising: (1) contacting in any order, a group 8-11 transition metal precursor, an olefin, carbon dioxide, a diluent, and a polyaromatic resin with associated metal cations to provide a reaction mixture; and (2) applying conditions to the reaction mixture suitable to produce the α,β -unsaturated carboxylic acid or a salt thereof. Methods of regenerating the polyaromatic resin with associated metal cations are described.

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2016/066360

A. CLASSIFICATION OF SUBJECT MATTER

INV. C07C51/15 C07C57/04
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)

C07C

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.
X	WO 2015/173296 A1 (BASF SE [DE]) 19 November 2015 (2015-11-19) pages 5,6 pages 18,19,22 pages 34-35; claim 1 -----	1-75
A	WO 2015/173277 A1 (BASF SE [DE]) 19 November 2015 (2015-11-19) page 3, line 32 - page 4, line 34; claim 1; examples 1-196 page 19, lines 8-18 page 21, line 5 -----	1-75
A	WO 2013/098772 A1 (BASF SE [DE]; BASF CHINA CO LTD [CN]) 4 July 2013 (2013-07-04) pages 12-14; claim 1; examples 1-8 -----	1-75



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

19 July 2017

Date of mailing of the international search report

27/07/2017

Name and mailing address of the ISA/

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

Authorized officer

Matés Valdivielso, J

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2016/066360

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2015173296	A1	19-11-2015	NONE
WO 2015173277	A1	19-11-2015	CN 106458824 A 22-02-2017
		EP 3142995 A1 22-03-2017	
		US 2017107166 A1 20-04-2017	
		WO 2015173277 A1 19-11-2015	
WO 2013098772	A1	04-07-2013	CA 2862155 A1 04-07-2013
		CN 104011004 A 27-08-2014	
		EP 2797869 A1 05-11-2014	
		JP 6122030 B2 26-04-2017	
		JP 2015503547 A 02-02-2015	
		WO 2013098772 A1 04-07-2013	