

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
30 July 2009 (30.07.2009)

PCT

(10) International Publication Number
WO 2009/094505 A1

(51) International Patent Classification:
B01J 8/00 (2006.01) **C08F 10/00** (2006.01)
B01J 8/24 (2006.01) **C08F 2/34** (2006.01)
B01J 19/26 (2006.01)

(74) Agent: **SELLERS, James**; 2030 Dow Center, Midland,
Michigan 48674 (US).

(21) International Application Number:
PCT/US2009/031778

(22) International Filing Date: 23 January 2009 (23.01.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/023,298 24 January 2008 (24.01.2008) 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, BR, BW, BY, BZ, CA,
CH, 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, KM, 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, PG, PH, PL, PT,
RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ,
TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM,
ZW.

(71) Applicant (for all designated States except US): **DOW
GLOBAL TECHNOLOGIES INC.** [US/US]; 2040 Dow
Center, Midland, MI 48674 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **LIPP, Charles**
[US/US]; 206 Flag Drive West, Lake Jackson, TX 77566
(US). **DENTON, David** [US/US]; 3018 Planters Loop,
Angleton, TX 77515 (US). **GERTNER, Bruce** [US/US];
116 Andrew Drive, Victoria, TX 77904 (US).

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European (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, SE, SI, SK, TR), OAPI (BF, BJ,
CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN,
TD, TG).

Published:
— with international search report

(54) Title: METHOD FOR GAS PHASE POLYMERIZATION

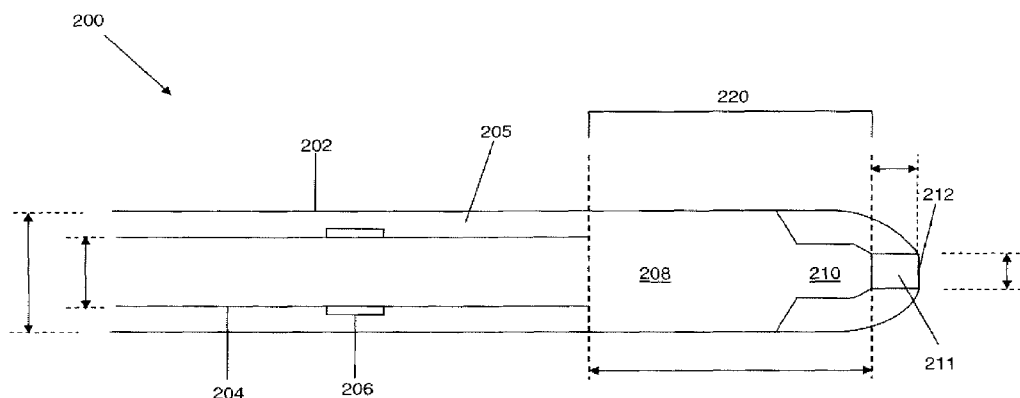


FIG. 2

(57) Abstract: Disclosed is a catalyst injection nozzle that comprises an outer tube with an open end, a nozzle tip with a diameter connected to the outer tube open end, an orifice connected to the nozzle tip internal to the outer tube, an internal mixing zone connected to the orifice internal to the outer tube, an inner tube residing within the outer tube further comprising an open end connected to the internal mixing zone, where a steady-state, uniform two-phase flow regime between an atomizing gas and at least one liquid catalyst feed does not form in the internal mixing zone at an atomizing gas to liquid catalyst feed flow ratio of about 0.05 to about 10.

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