(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
04 May 2023 (04.05.2023)

WIPO | PCT

(10) International Publication Number
WO 2023/077002 A1

(51) International Patent Classification:
H01J 37/32 (2006.01)

(21) International Application Number:
PCT/US2022/078786

(22) International Filing Date:
27 October 2022 (27.10.2022)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
63/263,290 29 October 2021 (29.10.2021) US

(71) Applicant: **LAM RESEARCH CORPORATION** [US/US]; 4650 Cushing Parkway, Fremont, California 94538 (US).

(72) Inventors: **MILLER, Aaron Blake**; 4650 Cushing Pkwy., Fremont, California 94538 (US). **BHIMARASETTI, Gopinath**; 4650 Cushing Pkwy., Fremont, California 94538 (US). **HART, Kyle Watt**; 4650 Cushing Pkwy., Fremont, California 94538 (US).

(74) Agent: **HO, Michael T.**; Weaver Austin Villeneuve & Sampson LLP, P.O. Box 70250, Oakland, California 94612-0250 (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, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, 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, ST, SV, SY, TH,

WO 2023/077002 A1

(54) Title: SHOWERHEAD WITH HOLE SIZES FOR RADICAL SPECIES DELIVERY

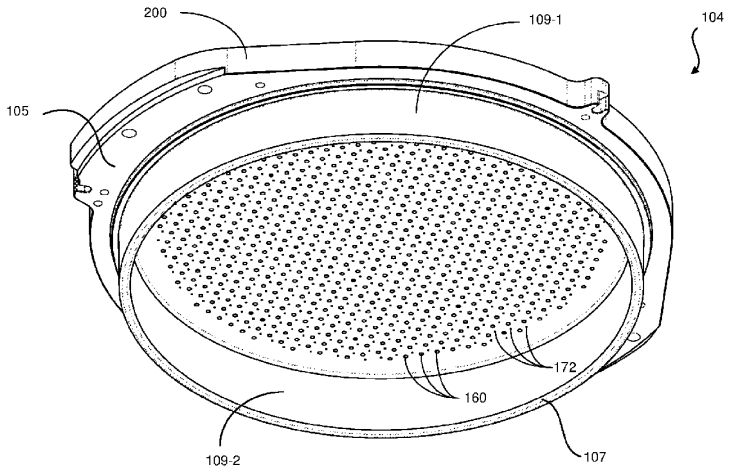


Fig. 8

(57) Abstract: A showerhead comprises a first set of holes and a second set of holes. The first set of holes have a greater diameter and length than the second set of holes. The first set of holes extend through a thickness of the showerhead. In some embodiments, the showerhead includes a base portion and a cylindrical portion extending perpendicularly from the base portion. The base portion may define a plenum that is in fluid communication with the second set of holes but separate from the first set of holes. The second set of holes extend from the plenum to a bottom surface of the showerhead. In some implementations, the first diameter of the first set of holes may be optimized to filter ions from a plasma, pass radicals from the plasma through the showerhead, and to limit back-diffusion of precursors through the showerhead.

[Continued on next page]

TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, CV, 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, ME, 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))*