

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

(19) World Intellectual Property
Organization
International Bureau

(43) International Publication Date
15 September 2022 (15.09.2022)



(10) International Publication Number
WO 2022/191955 A1

(51) International Patent Classification:
H01L 21/67 (2006.01) *H01L 21/02* (2006.01)
B08B 7/00 (2006.01)

(21) International Application Number:
PCT/US2022/016332

(22) International Filing Date:
14 February 2022 (14.02.2022)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
17/200,408 12 March 2021 (12.03.2021) US

(71) Applicant: **APPLIED MATERIALS, INC.** [US/US];
3050 Bowers Avenue, Santa Clara, California 95054 (US).

(72) Inventors: **WU, Banqiu**; c/o Applied Materials, Inc., Law
Dept., M/s 1269, 3050 Bowers Avenue, Santa Clara, Cal-
ifornia 95054 (US). **DAGAN, Eli**; c/o Applied Materials,
Inc., Law Dept., M/s 1269, 3050 Bowers Avenue, Santa
Clara, California 95054 (US).

(74) Agent: **PATTERSON, B. Todd** et al.; PATTERSON +
SHERIDAN LLP, 24 Greenway Plaza, Suite 1600, Hous-
ton, Texas 77046 (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, IT, JM, JO, 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,

(54) Title: ATOMIC OXYGEN AND OZONE CLEANING DEVICE HAVING A TEMPERATURE CONTROL APPARATUS

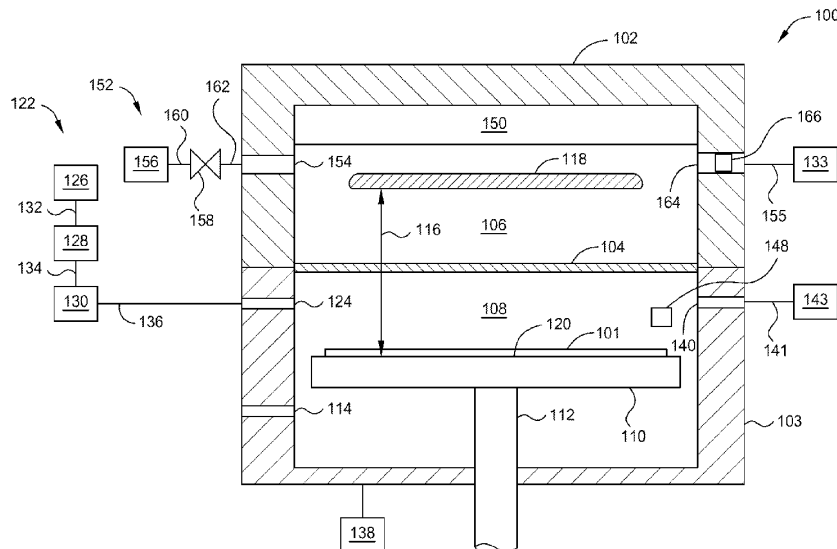


FIG. 1A

(57) **Abstract:** Embodiments of the present disclosure relate to an oxygen cleaning chamber with UV radiation generator temperature control and a method of atomic oxygen cleaning a substrate. The atomic oxygen cleaning chamber includes a process chamber and a cooling chamber coupled to the process chamber and a divider sealingly separating the process chamber from the cooling chamber. An ultraviolet (UV) radiation generator is disposed in the cooling chamber and provides UV radiation through the divider into the process chamber. A gas distribution assembly distributes ozone over an upper surface of a pedestal in the process chamber and a coolant distribution assembly distributes cooling gas into the cooling chamber to cool the UV radiation generator. By actively cooling the UV radiation generator, a higher intensity UV radiation at a stable wavelength is produced, i.e., without wavelength drift normally associated with high power UV radiation generator outputs.

[Continued on next page]

WO 2022/191955 A1

RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, 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, 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).

Published:

— *with international search report (Art. 21(3))*