

(43) International Publication Date
02 May 2024 (02.05.2024)



(10) International Publication Number
WO 2024/088719 A1



- (51) **International Patent Classification:**
H01J 37/32 (2006.01) **H05H 1/48** (2006.01)

(21) **International Application Number:**
PCT/EP2023/077486

(22) **International Filing Date:**
04 October 2023 (04.10.2023)

(25) **Filing Language:** English

(26) **Publication Language:** English

(30) **Priority Data:**
22204252.5 27 October 2022 (27.10.2022) EP

(71) **Applicant (for all designated States except BB, CN):**
NANOFILM TECHNOLOGIES INTERNATIONAL LIMITED [SG/SG]; Nanofilm Technologies International Limited, 11 Tai Seng Drive, Singapore 535226 (SG).

(71) **Applicant (for CN only):** **NANOFILM VACUUM COATING (SHANGHAI) CO., LTD.** [CN/CN]; 399 Songhui Road, Qingpu District, Shanghai 201703 (CN).

(71) **Applicant (for BB only):** **SCHLICH** [GB/GB]; 9 St Catherine's Road, Littlehampton Sussex BN17 5HS (GB).

(72) **Inventors:** **ZHAO, Shengfu**; c/o Nanofilm Technologies International Limited, 11 Tai Seng Drive, Singapore 535226 (SG). **SHI, Xu**; c/o Nanofilm Technologies International Limited, 11 Tai Seng Drive, Singapore 535226 (SG). **ZHANG, Guangyi**; c/o Nanofilm Technologies International Limited, 11 Tai Seng Drive, Singapore 535226 (SG).

(74) **Agent:** **BAJJON, Alexander**; 9 St Catherine's Road, Littlehampton, Sussex BN17 5HS (GB).

(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, MU, 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, 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, SC, 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,

(54) **Title:** HOLLOW CATHODE ARC PLASMA DEVICE

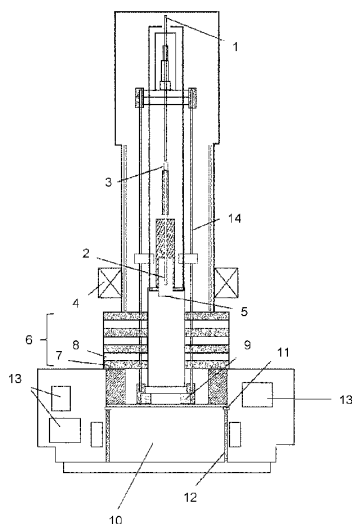


Fig. 1

(57) Abstract: The invention provides an apparatus for generating a plasma from a process gas, the apparatus comprising: a) a power supply b) a hollow cathode arc tube comprising: i) an inert gas inlet ii) a cathode tube connected to the power supply and arranged to be negatively biased when the power supply is on iii) an anode tube connected to the power supply and arranged to be positively biased when the power supply is on iv) an electron beam outlet c) an ionisation chamber comprising: i) an electron beam inlet ii) a process gas inlet iii) a volume in which ionisation of the process gas can take place to form the plasma iv) a plasma outlet d) a first magnetic field source for confining the plasma inside the ionisation chamber e) a second magnetic field source for directing and scanning plasma out of the plasma outlet. The invention further provides a method of generating a plasma beam.

WO 2024/088719 A1

[Continued on next page]

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).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*
— *in black and white; the international application as filed
contained color or greyscale and is available for download
from PATENTSCOPE*