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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
30 March 2023 (30.03.2023)

WIPO | PCT

(10) International Publication Number
WO 2023/049341 A1

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

(21) International Application Number:
PCT/US2022/044531

(22) International Filing Date:
23 September 2022 (23.09.2022)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
17/484,204 24 September 2021 (24.09.2021) US

(71) Applicants: **TOKYO ELECTRON LIMITED** [JP/JP]; 3-1 Akasaka 5-chome, Minato-ku, Tokyo, Tokyo 107-6325 (JP). **TOKYO ELECTRON U.S. HOLDINGS, INC.** [US/US]; 2400 Grove Boulevard, Austin, Texas 78741 (US).

(72) Inventors: **IP, Nathan**; 2400 Grove Blvd., Austin, Texas 78741 (US). **WOOLEY, Megan**; 2400 Grove Blvd., Austin, Texas 78741 (US).

(74) Agent: **MEHIGAN, Jason D.**; 2400 Grove Blvd., Austin, Texas 78741 (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, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO,

(54) Title: METHOD AND PROCESS USING FINGERPRINT BASED SEMICONDUCTOR MANUFACTURING PROCESS FAULT DETECTION

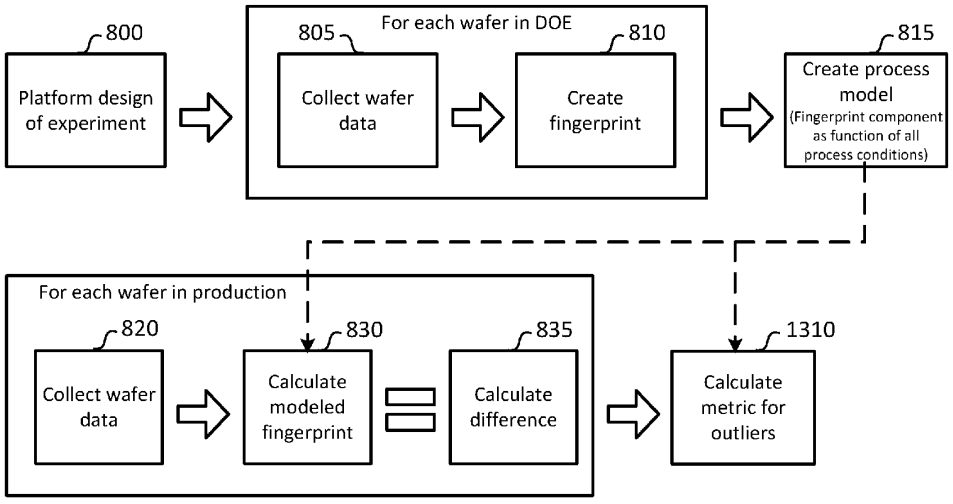


Figure 13

(57) Abstract: Sensitivity calculations are provided of a process model through the rate of change of a model fingerprint with respect to process variables and defects. A fingerprint sensitivity table is generated, where process variables are associated with a set of fingerprint sensitivities. The fingerprint of incoming substrates is monitored through a production process by applying the same fingerprint method that is used in the process model. Calculations are made of the difference between the incoming substrate fingerprint and the process model predicted fingerprint. This difference fingerprint is compared against the table of fingerprint sensitivities to find the process variable most likely to be responsible for the difference. Spatial relationships between process variables and actual measurements on the substrate may be obtained. Correlation through fingerprint sensitivity improves the ability to pinpoint faulty process tools. The difference fingerprint may also identify the formation of defects on a substrate.

WO 2023/049341 A1

[Continued on next page]

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, 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))*