



(51) International Patent Classification:
H01L 21/66 (2006.01)

(21) International Application Number:
PCT/US2017/055436

(22) International Filing Date:
05 October 2017 (05.10.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/405,435 07 October 2016 (07.10.2016) US
15/683,077 22 August 2017 (22.08.2017) US

(71) Applicant: **KLA-TENCOR CORPORATION** [US/US];
Legal Department, One Technology Drive, Milpitas, California 95035 (US).

(72) Inventors: **KOLCHIN, Pavel**; 38882 Chery Glen, Fremont, California 94536 (US). **DANEN, Robert**; 787 Sylvaner Drive, Pleasanton, California 94566 (US). **MEASOR, Philip**; 1242 Minnesota Avenue, San Jose, California 95125 (US).

(74) Agent: **MCANDREWS, Kevin** et al.; KLA-Tencor Corp., Legal Department, One Technology Drive, Milpitas, California 95035 (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, 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, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, 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).

(54) Title: **THREE-DIMENSIONAL IMAGING FOR SEMICONDUCTOR WAFER INSPECTION**

(57) Abstract: Methods and systems for improved detection and classification of defects of interest (DOI) on semiconductor wafers based on three-dimensional images are described herein. Three dimensional imaging of volumes of thick, layered structures enables accurate defect detection and estimation of defect location in three dimensions at high throughput. A series of images are acquired at a number of different wafer depths. A three dimensional image of a thick semiconductor structure is generated from the series of images. Defects are identified and classified based on an analysis of the three dimensional image of the thick semiconductor structure. In some examples, the three-dimensional image stack is visualized by contour plots or cross-sectional plots to identify a characteristic defect response. In some examples, the three-dimensional image is processed algorithmically to identify and classify defects. In another aspect, the location of a defect is estimated in three dimensions based on the three dimensional image.

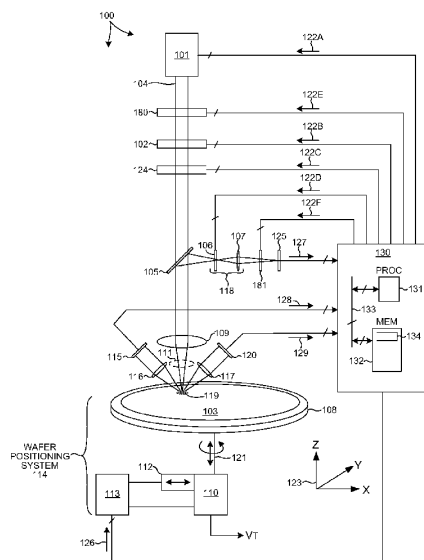


FIG. 1

Published:

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