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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : H01L 21/00 — A2

(11) International Publication Number: WO 00/33359

(43) International Publication Date: 8 June 2000 (08.06.00)

(21) International Application Number: PCT/US99/28737

(22) International Filing Date: 2 December 1999 (02.12.99)

(30) Priority Data:

09/204,747	2 December 1998 (02.12.98)	US
09/312,343	14 May 1999 (14.05.99)	US

(63) Related by Continuation (CON) or Continuation-in-Part (CIP) to Earlier Application

US 09/312,343 (CIP)
Filed on 14 May 1999 (14.05.99)

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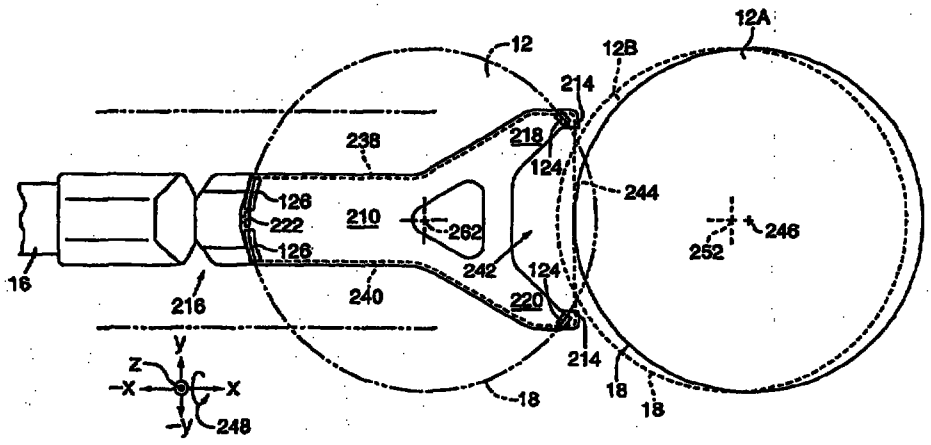
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(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: SPECIMEN HOLDING ROBOTIC ARM END EFFECTOR



(57) Abstract

Robot arm (16) end effectors (10, 110, 210) of this invention rapidly and cleanly transfer semiconductor wafers (12) between a wafer cassette (14) and a processing station. The end effectors include proximal and distal rest pads (24, 26, 124, 126) having pad and backstop portions (32, 34, 132, 134) that support and grip the wafer either by wafer peripheral edge contact or within an annular exclusion zone (30) that extends inward from a peripheral edge of the wafer. An active contact point (50, 150, 222) is movable by a vacuum actuated piston (52, 152) between a retracted wafer-loading position and an extended position that urges the wafer against the distal rest pads to grip the wafer at its edge or within the exclusion zone. The end effector further includes fiber optic light transmission sensors (90, 102, 202, 214) for determining various wafer surface, edge, thickness, tilt, and location parameters. The sensors provide robot arm extension and elevation positioning data supporting methods of rapidly and accurately placing and retrieving a wafer from among a stack of closely spaced wafers stored in the wafer cassette. The methods effectively prevent accidental contact between the end effector and the wafers while effecting clean, secure gripping of the wafer at its edge or within its exclusion zone.