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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
15 April 2004 (15.04.2004)

PCT

(10) International Publication Number
WO 2004/031875 A1

(51) International Patent Classification[7]: G05B 19/418

(21) International Application Number: PCT/US2003/029980

(22) International Filing Date: 25 September 2003 (25.09.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/414,425 30 September 2002 (30.09.2002) US

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(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, 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, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,

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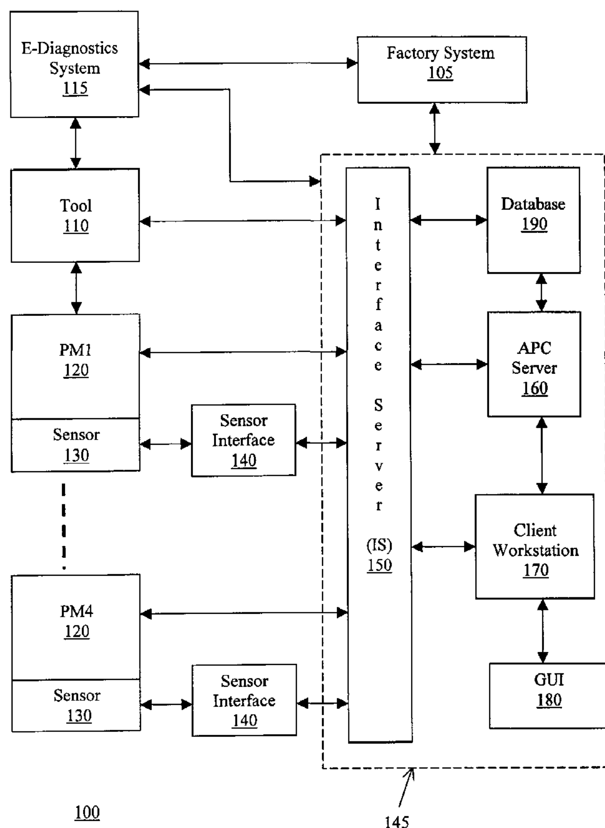
(54) Title: METHOD AND APPARATUS FOR THE MONITORING AND CONTROL OF A SEMICONDUCTOR MANUFACTURING PROCESS



(57) Abstract: An Advanced Process Control (APC) system including Graphical User Interfaces (GUIs) is presented for monitoring and controlling a semiconductor manufacturing process that is performed by a semiconductor processing system. The semiconductor processing system includes a number of processing tools, a number of processing modules (chambers), and a number of sensors, and the APC system comprises an APC server, database, interface server, client workstation, and GUI component. The GUI is webbased and is viewable by a user using a web browser.

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SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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Method and Apparatus for the Monitoring and Control of a Semiconductor Manufacturing Process

Cross-reference to Related Applications

[0001] The present application is based on and derives benefit from US Provisional Application No. 60/414,425, filed September 30, 2002, the entire contents of which are incorporated herein by reference.

[0002] The present application is related to co-pending applications US Provisional Application No. 60/368,162, entitled "Method For Interaction With Status and Control Apparatus", filed on March 29, 2002; US Provisional Application No. 60/374,486, entitled "Method and Apparatus for Simplified System Configuration", filed on April 23, 2002; US Provisional Application No. 60/383,619, entitled "Method and Apparatus For Monitoring Tool Performance", filed on May 29, 2002; US Provisional Application No. 60/393,091, entitled "Method for Dynamic Sensor Configuration and Runtime Execution", filed on July 3, 2002; and US Provisional Application No. 60/393,104, entitled "Method and Apparatus for Automatic Sensor Installation", filed on July 3, 2002. Each of these applications is herein incorporated by reference in its entirety.

Field of the Invention

[0003] The present invention is related to semiconductor processing systems, particularly to semiconductor processing systems, which use Advanced Process Control (APC).

Background of the Invention

[0004] Computers are generally used to control, monitor, and initialize manufacturing processes. A computer is ideal for these operations given the complexities in a semiconductor manufacturing plant from the reentrant wafer flows, critical processing steps, and maintainability of the processes. Various input/output (I/O) devices are used to control and monitor process flows, wafer states, and maintenance schedules. A variety of tools exist in a semiconductor manufacturing plant to complete these complicated steps from critical operations such as etching, to batch processing, and inspections. Most tool installations are accomplished using a display screen that is part of the

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graphical user interface (GUI) of a control computer containing the installation software. Installation of a semiconductor-processing tool is a time consuming procedure.

[0005] Semiconductor processing facilities require constant monitoring. Processing conditions change over time with the slightest changes in critical process parameters creating undesirable results. Small changes can easily occur in the composition or pressure of an etch gas, process chamber, or wafer temperature. In many cases, changes of process data reflecting deterioration of processing characteristics cannot be detected by simply referring to the process data displayed. It is difficult to detect early stage abnormalities and characteristic deterioration of a process. Oftentimes prediction and pattern recognition offered by advanced process control (APC) is necessary.

[0006] Facility control is often performed by a number of different control systems having a variety of controllers. Some of the control systems may have man-machine interfaces such as touch screens, while others may only collect and display one variable such as temperature. The monitoring system must be able to collect data tabulated for the process control system. The data collection of the monitoring system must handle univariate and multivariate data, the analysis and display of the data, and have the ability to select the process variables to collect. Various conditions in a process are monitored by different sensors provided in each of the process chambers, and data of the monitored conditions is transferred and accumulated in a control computer. If the process data is displayed and detected automatically, the optimum process conditions of a mass-production line can be set and controlled through statistical process control (SPC) charts. Inefficient monitoring of a facility can result in facility downtimes that add to the overall operational cost.

Summary of the Invention

[0007] Accordingly, it is an object of the present invention to provide an Advanced Process Control (APC) system for controlling a processing tool in a semiconductor processing environment, where the APC system comprises an APC server providing a plurality of APC related applications; an Interface

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Server (IS) coupled to the APC server; a database coupled to the IS and APC server; and a GUI component coupled to the APC server, wherein the IS comprises means for coupling to a processing tool, and means for coupling to a plurality of process modules coupled to the processing tool.

[0008] In addition, it is an object of the present invention to provide a method for using an Advanced Process Control (APC) system for controlling a processing tool in a semiconductor processing environment, the method comprising: providing an APC server providing a plurality of APC related applications; providing an Interface Server (IS) coupled to the APC server; providing a database coupled to the IS and APC server; and providing a GUI component coupled to the APC server, wherein the IS comprises means for coupling to a processing tool, and means for coupling to a plurality of process modules coupled to the processing tool.

Brief Description of the Drawings

[0009] The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate presently preferred embodiments of the invention, and together with the general description given above and the detailed description of the preferred embodiments given below, serve to explain the principles of the invention. A more complete appreciation of the invention and many of the attendant advantages thereof will become readily apparent with reference to the following detailed description, particularly when considered in conjunction with the accompanying drawings, in which:

[0010] FIG. 1 shows an exemplary block diagram of an advanced process controlled (APC) system in a semiconductor manufacturing environment in accordance with one embodiment of the present invention;

[0011] . FIG. 2 shows an exemplary block diagram of a system from Tokyo Electron Inc;

[0012] FIG. 3 is a simplified data flow diagram for the APC system in accordance with one embodiment of the present invention;

[0013] FIG. 4 illustrates a simplified interface diagram in accordance with an embodiment of the present invention;

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