US006836691B1

(12) **United States Patent**
Stirton

(10) **Patent No.: US 6,836,691 B1**
(45) **Date of Patent: Dec. 28, 2004**

(54) **METHOD AND APPARATUS FOR FILTERING METROLOGY DATA BASED ON COLLECTION PURPOSE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/427,620**

(22) Filed: **May 1, 2003**

(51) **Int. Cl.**[7] **G06F 19/00**
(52) **U.S. Cl.** **700/108**; 702/85
(58) **Field of Search** 700/108, 95, 110, 700/117; 702/85; 709/108, 320; 712/228; 714/25, 54; 438/12; 345/708

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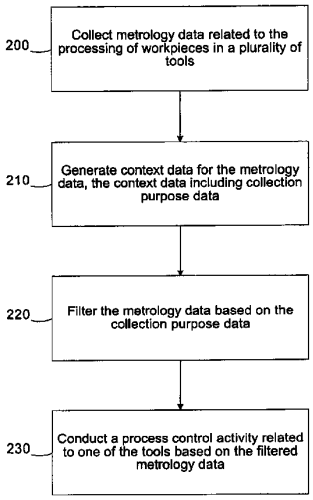
(57) **ABSTRACT**

A method includes collecting metrology data related to the processing of workpieces in a plurality of tools. Context data for the metrology data is generated. The context data includes collection purpose data. The metrology data is filtered based on the collection purpose data. A process control activity related to one of the tools is conducted based on the filtered metrology data. A system includes at least one metrology tool, a computer, and a process controller. The metrology tool is configured to collect metrology data related to the processing of workpieces in a plurality of tools. The computer is configured to generate context data for the metrology data, the context data including collection purpose data. The process controller is configured to filter the metrology data based on the collection purpose data and conduct a process control activity related to one of the tools based on the filtered metrology data.

20 Claims, 2 Drawing Sheets



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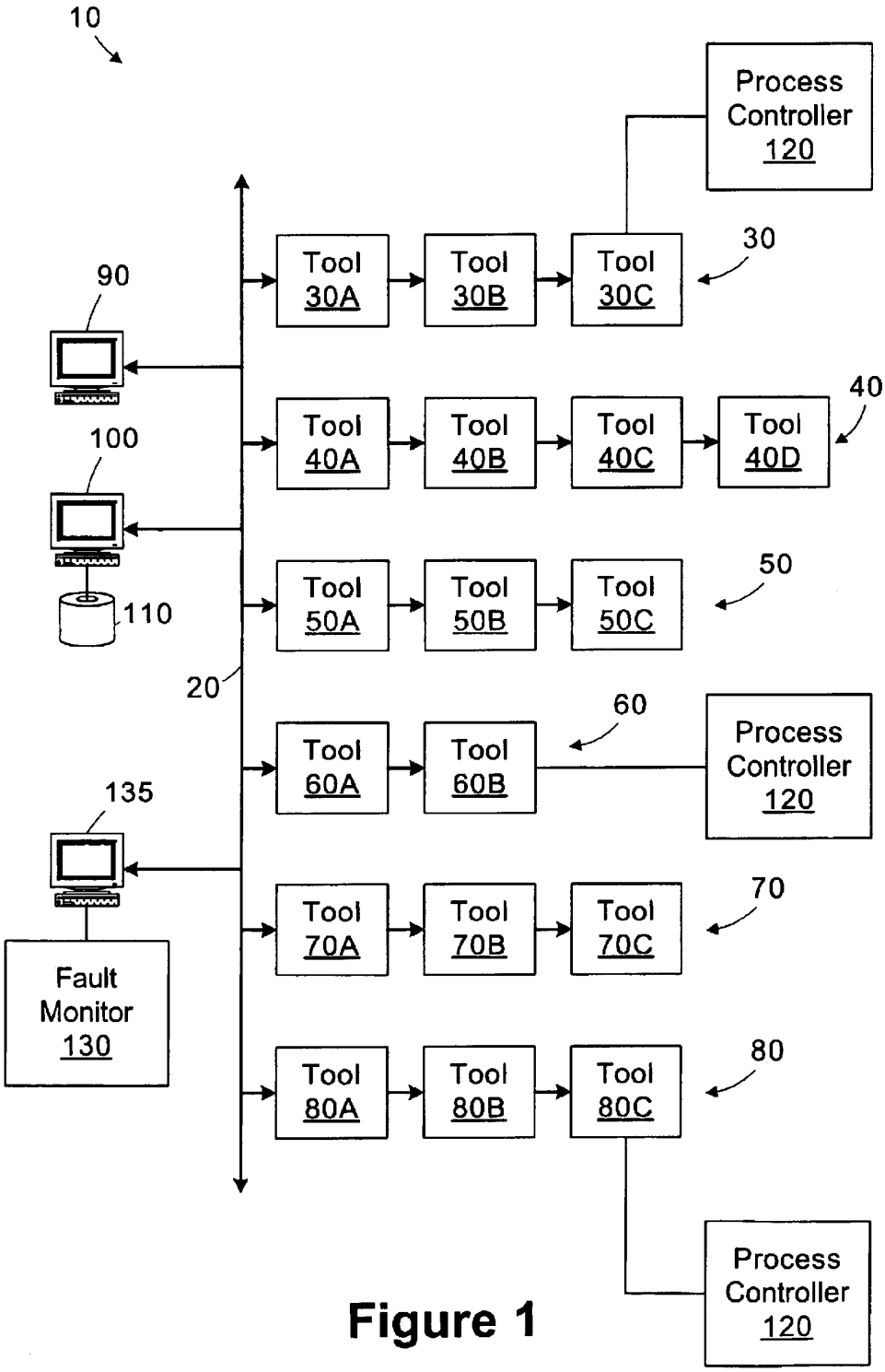

Figure 1

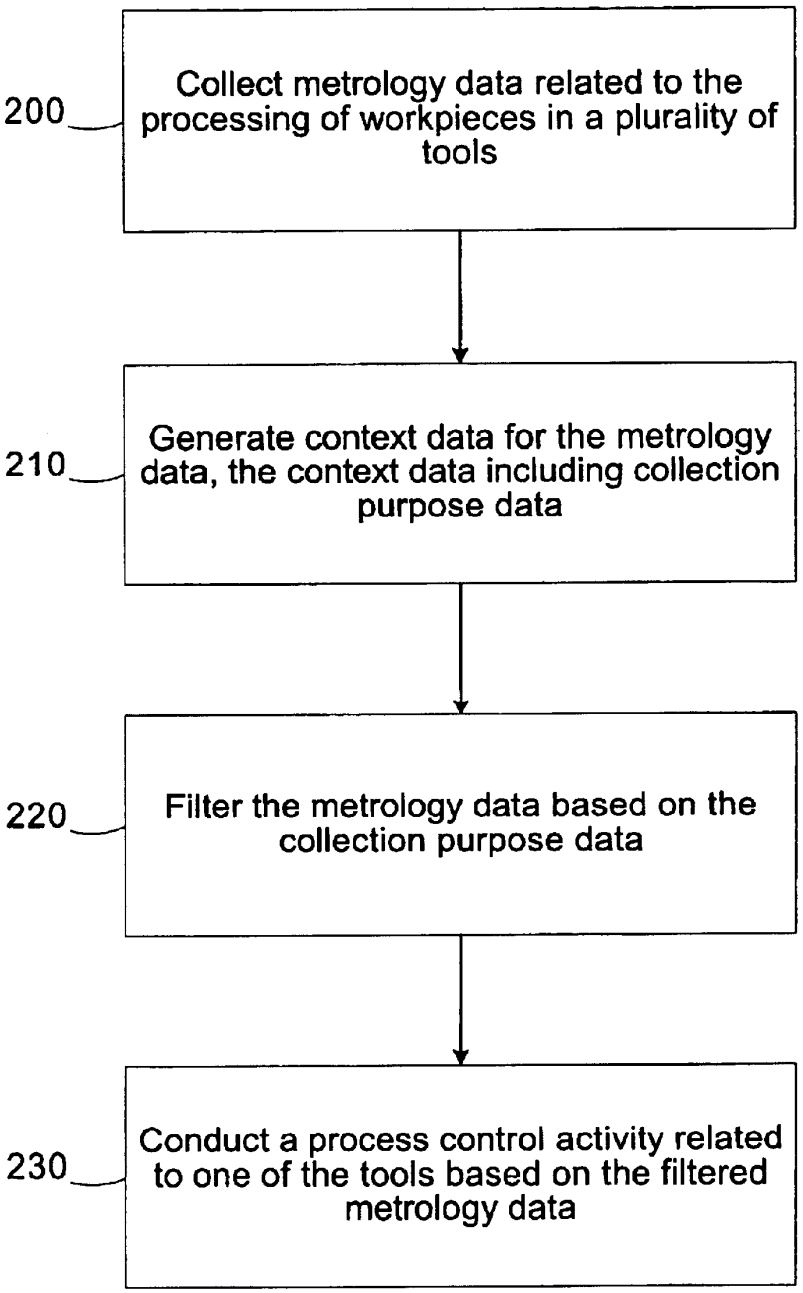

Figure 2

METHOD AND APPARATUS FOR FILTERING METROLOGY DATA BASED ON COLLECTION PURPOSE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to an industrial process, and, more particularly, to a method and apparatus for filtering metrology data based on collection purpose in a semiconductor device manufacturing environment

2. Descripiion of the Related Art

There is a constant drive within the semiconductor industry to increase the quality, reliability and throughput of integrated circuit devices, e.g., microprocessors, memory devices, and the like. This drive is fueled by consumer demands for higher quality computers and electronic devices that operate more reliably. These demands have resulted in a continual improvement in the manufacture of semiconductor devices, e.g., transistors, as well as in the manufacture of integrated circuit devices incorporating such transistors. Additionally, reducing the defects in the manufacture of the components of a typical transistor also lowers the overall cost per transistor as well as the cost of integrated circuit devices incorporating such transistors.

Generally, a set of processing steps is performed on a wafer using a variety of processing tools, including photolithography steppers, etch tools, deposition tools, polishing tools, rapid thermal processing tools, implantation tools, etc. One technique for improving the operation of a semiconductor processing line includes using a factory wide control system to automatically control the operation of the various processing tools. The manufacturing tools communicate with a manufacturing framework or a network of processing modules. Each manufacturing tool is generally connected to an equipment interface. The equipment interface is connected to a machine interface which facilitates communications between the manufacturing tool and the manufacturing framework. The machine interface can generally be part of an advanced process control (APC) system. The APC system initiates a control script based upon a manufacturing model, which can be a software program that automatically retrieves the data needed to execute a manufacturing process.

Often, semiconductor devices are staged through multiple manufacturing tools for multiple processes, generating data relating to the quality of the processed semiconductor devices. Pre-processing and/or post-processing metrology data is collected on a regular basis, generally in accordance with a sampling plan, for process control purposes. The collected metrology data is used by the process controllers for the tools. Operating recipe parameters are calculated by the process controllers based on the performance model and the metrology information to attempt to achieve post-processing results as close to a process target value as possible. Reducing variation in this manner leads to increased throughput, reduced cost, higher device performance, etc., an of which equate to increased profitability.

Metrology data is also used for other purposes not related to process control. One such use is for fault detection and classification (FDC). Fault monitors apply FDC techniques to identify devices or tools with fault conditions. For example, if a particular device has a critical dimension outside a predetermined range, it is flagged as being defective. The wafer may be reworked, the die may be marked

defective, or the wafer may be scrapped, depending on the magnitude and nature of the fault condition. Process tools may be monitored during their processing runs. If an anomaly is observed during the processing, the tool may be shut down for maintenance. The wafers processed by the tool may be flagged for subsequent metrology to determine if the tool anomaly caused a degradation of the devices formed thereon. Again, the suspect wafers may be reworked or scrapped.

Typically, when a process controller gathers metrology data to update its control model or generate a control action for subsequent processing, it retrieves metrology data related to wafers processed in the tool or tools under its control and employs that data to perform its control task. The data retrieved includes metrology data collected through the regular sampling plans implemented in the facility, and the metrology data collected for other purposes. Some of the metrology data does not accurately reflect the state of the process or the devices manufactured. For example, devices processed by a tool that was malfunctioning may have characteristics that were affected by the malfunction (Le., a special cause) rather than by normal process variation (i.e., common cause). Employing this data for use in process control routines may introduce a source of variation that cannot be addressed by the process controller and thus reduce the effectiveness of the process controller.

The present invention is directed to overcoming, or at least reducing the effects of, one or more of the problems set forth above.

SUMMARY OF THE INVENTION

One aspect of the present invention is seen in a method for filtering metrology data. The method includes collecting metrology data related to the processing of workpieces in a plurality of tools. Context data for the metrology data is generated. The context data includes collection purpose data. The metrology data is filtered based on the collection purpose data. A process control activity related to one of the tools is conducted based on the filtered metrology data.

Another aspect of the present invention is seen in a system including at least one metrology tool, a computer, and a process controller. The metrology tool is configured to collect metrology data related to the processing of workpieces in a plurality of tools. The computer is configured to generate context data for the metrology data, the context data including collection purpose data. The process controller is configured to filter the metrology data based on the collection purpose data and conduct a process control activity related to one of the tools based on the filtered metrology data.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals identify like elements, and in which:

FIG. **1** is a simplified block diagram of a manufacturing system in accordance with one embodiment of the present invention; and

FIG. **2** is a simplified flow diagram of a method for filtering metrology data in accordance with another embodiment of the present invention.

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and are

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