A&D Receives Order From Sandia National Laboratories

In June 2009, A&D received an order for a large-scale focused ion beam system from Sandia National Laboratories in the United States. Sandia National Laboratories was established under the jurisdiction of the Energy Department in 1949 in Albuquerque, New Mexico. Sandia performs advanced research in various fields, including at The Center for Integrated Nanotechnologies (CINT), which Sandia jointly operates with the renowned Los Alamos National Laboratory. When Sandia decided to adopt focused ion beam (FIB) lithography equipment as a tool to create quantum devices* as part of their advanced ion beam research, they chose A&D.

* Quantum devices
Electrons have wave properties in addition to their natural characteristics as electrons (particles) in circuits with extremely narrow line width (as narrow as several tens of nanometers). Quantum devices are being studied as devices that utilize both of these characteristics.

1. Configuration and features

This system is composed of four parts.

- A 100 kV FIB unit
- A sample holder for a 4-inch wafer
- A sample stage and measuring device to control the position of the sample at the nanometer level.
- A vacuum unit to keep the sample in a vacuum environment

To create the microscopic patterns with ion beams, the system also includes control and management software for user-created patterns from computer aided design (CAD) programs, and a D/A converter and beam position control unit to control the ion beam as it forms a pattern.

2. Functions

1. Ion implantation
Metallic ions are shot at a 4-inch silicon sample surface to create semiconductors and ICs on a board. The combination of the beam position deflection function and the sample position moving mechanism makes it possible to create semiconductors and ICs of the desired size at the desired location.
2. Single ion implantation
This system can also control single ions using the same procedure as ion implantation. Usually, ion

beams flow like water from a tap. However, decreasing the beam volume and flow time (nanoseconds to microseconds) changes the flow to single ion particles. This makes it possible to implant metallic ions one by one at a desired location with an accuracy of 10 nm or greater. Because metal is configured at the atomic level, the circuits created have a much narrower line width compared to traditional semiconductor circuits, which may lead to the development of new semiconductor devices that exhibit quantum phenomena.

3. Nanoprocessing

In addition to transporting matter to the sample surface, FIB systems can also machine samples to create tiny holes and lines and thus can be used as a nanotechnology and nanostructure creation tool.

Image of an installed system