

## G-Device@BEANS Project for Green Innovation

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With problems of the environment and energy resources now acknowledged as global issues, there is strong pressure on every country and industry to implement more eco-friendly measures. Specifically, it is vital to conserve resources and work toward high efficiency and low environmental impact in order to reduce greenhouse gas emissions by 25%. With this backdrop, in response to a call for research proposals from the New Energy and Industrial Technology Development Organization (NEDO), the Hetero-functional Integrated Device Technology Development Project (the BEANS Project) added a new R&D project entitled "Research and development of an advanced sensor network system and environmentally friendly processes," which was launched in FY 2009 and is being pursued through FY 2010. The newest BEANS R&D project "G-Device@BEANS" is aimed at developing a sensor network system capable of monitoring energy usage in real-time, controlling the air conditioning system, and the like. The project calls for constructing a clean room as a testing ground and installing an 8-inch MEMS production line therein. Numerous high-performance MEMS sensor modules will then be arranged in the clean room to provide detailed information. Wireless communications will be essential for installing sensor chips freely within the network. Therefore, we will attempt to identify any technical issues such as what type of integrated MEMS sensor chip will be compatible with wireless communication LSI and can be configured of a large number of multifunctional sensors while being micro-sized inexpensively. Concurrently, we will be developing environmentally friendly MEMS fabrication technologies, such as the use of an alternative gas for deep etching and low-temperature wafer-level packaging. Further, in order to develop and manufacture prototypes for hetero-functional integrated devices and integrated sensor devices more effectively and efficiently, we will be formulating high-quality processes for an 8-inch MEMS production line, gathering process recipes to support new materials and new structures, improving the design technology for controlling process machinery, and researching and developing technologies for processing environmentally friendly, biocompatible polymers.

The BEANS Laboratory has adopted a spirit of open innovation. By making use of the infrastructure in place at the Tsukuba Innovation Arena N-MEMS aimed at the development of new technologies and industries and establishing a research center at Ritsumeikan University, we can take advantage of these assets to carry out more efficient and effective R&D. In this report, the details of G-Device@BEANS project research items will be introduced.

- 1. Development of an advanced sensor network system**
  - Produce a prototype of a sensor network system for sensing energy consumption, temperature, pressure, air volume, foreign particles, gas, etc. in a MEMS clean room for large-diameter wafers in order to analyze the effects on energy savings and reducing carbon content.
  - Formulate new sensing principles aimed at the development of advanced integrated sensor chips capable of wireless communications with a wireless-independent power supply and having a small size and low profile and a highly sensitive sensing capacity.
- 2. Development of environmentally friendly processes**
  - Develop an efficient etching process for deep etching of silicon that has low environmental impact through an alternative gas to SF<sub>6</sub>.
  - Integrate various heterogeneous devices at the wafer level.
  - Use polymer MEMS to reduce the environmental impact of processes and devices.
  - Improve yield, quality, and throughput by designing and prototyping devices and processes using large-diameter test element groups, sharing information between the design and inspection stages, and providing design feedback from the inspection and measurement data.
  - Implement information sharing at the design stage with consideration for environmental impact.

