Hitachi and Renesas Technology Develop Low-Power MOS Phase-Change Memory Cells for On-Chip Memory of Microcontrollers

The new cell, which can be programmed at a 1.5V power supply voltage with only a 100μA programming current, is a promising solution for the on-chip nonvolatile memory of next-generation microcontrollers for embedded systems.

TOKYO — December 13, 2005 — Hitachi, Ltd. (NYSE:HIT / TSE: 6501) and Renesas Technology Corp. today announced the successful prototyping of low-power phase-change memory cells. The nonvolatile semiconductor storage elements can be programmed at a power supply voltage of 1.5V and a low current of 100μA — about 50 percent less power consumption per cell than previous technology reported by Hitachi and Renesas. Moreover, the new phase-change cells compare favorably with existing nonvolatile memory in terms of high-speed writing and reading capabilities, high programming endurance, small size, and high-level integration. Thus, they provide a promising solution for on-chip program and data storage in next-generation microcontrollers for embedded applications such as information devices, home electric appliances, and in-vehicle equipment and control systems.

The prototype cells were fabricated in a 130-nanometer CMOS process. Their structure uses MOS transistors and a phase-change film that enters an amorphous state* (high resistance) or crystalline state (low resistance) in response to heat. They are programmed to one state or the other via a tungsten bottom-electrode contact (BEC) with a diameter of 180nm. In a read operation, the stored digital (1 or 0) information is determined from a difference in the amount of current flowing in the film.

To obtain the breakthrough power-consumption results, the Hitachi and Renesas researchers developed an original phase-change film with low-current, low-voltage programming capability. They produced the film by controlled oxygen doping of a germanium-antimony-tellurium (GeSbTe) material. The oxygen doping enables the resistance of the phase-change film to be constrained to an optimal level and suppresses the flow of excessively large currents during programming. Also, the cell implementation allows the gate widths of the MOS transistors forming the cells to be decreased and the drive output MOS transistors to be reduced, making it possible to shrink the size of the memory cells and drive circuitry.

Details of the breakthrough low-power MOS phase-change memory cell technology were revealed in a technical paper presented at the International Electron Devices Meeting held in Washington D.C. from December 5, 2005.

About Hitachi, Ltd.
Hitachi, Ltd., (NYSE: HIT), headquartered in Tokyo, Japan, is a leading global electronics company with approximately 347,000 employees worldwide. Fiscal 2004 (ended March 31, 2005) consolidated sales totaled 9,027.0 billion yen ($84.4 billion). The company offers a wide range of systems, products and services in market sectors including information systems, electronic devices, power and industrial systems, consumer products, materials and financial services. For more information on Hitachi, please visit the company's website at http://www.hitachi.com.

About Renesas Technology Corp.
Renesas Technology Corp. designs and manufactures highly integrated semiconductor system solutions for automotive, mobile and PC/AV markets. Established on April 1, 2003 as a joint venture between Hitachi, Ltd. (TSE:6501, NYSE:HIT) and Mitsubishi Electric Corporation (TSE:6503) and headquartered in Tokyo, Japan, Renesas Technology is one of the largest semiconductor companies in the world and the world-leading microcontroller supplier globally. Besides microcontrollers, Renesas Technology offers system-on-chip devices, Smart Card ICs, mixed-signal products, flash memories, SRAMs and more.
www.renesas.com

* Amorphous state: A state in which the atoms or molecules making up a solid do not have a regular structure, such as a crystalline structure. (Also referred to as a noncrystalline state.)

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