Preface
Advanced Devices : The Future and Fujitsu's Approach to Development

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Over the past decade, as evidenced by the emerging multimedia society, we have seen tremendous progress in data processing and communication technologies. This progress has largely been dependent on the steady development of new devices and device technologies. In this special issue, we present some examples of the many important contributions that Fujitsu is making to this development.

The following are some of our projections for the years 2010 to 2020. A 64-Gbit DRAM and sub 0.1-micron logic technologies will be developed by 2010, and 1- to 16-Tbit devices for data processing should be realized by around 2020. Regarding fiber-optic communication systems, we expect the arrival of Tb/s communication systems by 2010 and throughputs of 10 to 100 Tb/s by 2020. To solve the bottleneck problem in data processing, it will be necessary to introduce optical technologies such as optical interconnections between boards and between chips. Progress in mobile communications will enable fast moving vehicles, for example, bullet trains, to receive real-time video data.

We have a two-fold approach toward device development, one is to develop devices and technologies for the near future, which mostly means extending present technologies; and the other is to prepare for the more distant future, that is, the years from 2010 to 2020. Some examples of the devices and technologies we are developing for the near future are low-cost and high-performance lasers and GaAs-based electronic devices for fiber optics and mobile systems, devices for high-density disk memories, and technologies for 1- to 4-Gbit DRAMs.

For the years 2010 to 2020, we believe that new device principles must be discovered and exploited and new material technologies must

be developed. For example, to read or write a single bit in a 64-Gbit device, we will have to control a mere 200 electrons; for a Tbit device, the number will be as low as 40 electrons. Also, lasers for chip-to-chip interconnections will need to have a high heat tolerance and an extremely low power consumption. Such devices will not be realized unless we do the basic physics needed to discover new device principles and develop new material technologies. Our strategy is to perform research for 2010 to 2020 and at the same time extend our present technologies. This will bring about new ideas and advancements for today's devices and also prepare us for the future.

The papers in this special issue were selected to represent our two-fold approach toward device development. Two of the papers are about Si-based devices. One of these describes a PMOSFET with a 0.04 μm gate length, and the other is on a futuristic single-electron-controlled memory. In the area of compound semiconductor-based electronic devices, there is a paper on a 76-GHz HEMT-based device for automotive radar applications and two papers on quantum dot memory units that are being developed for Tbit SRAMs and Tbit high-density optical memories using the newly discovered phenomena of spectral-hole burning. Turning to disk memories, this special issue includes a paper on a GaN-based blue laser for higher density optical disks and a paper on ferromagnetic tunnel junction magnetic read heads for high-density storage. Lastly, in the optical communication area, there are two papers on ultralow-power-consumption and high-temperature operating semiconductor lasers that are based on new material technologies and a paper on a nonlinear optical device for wavelength conversion.

Although this special issue covers just a small fraction of our device-technology activities, we hope it will give readers a glimpse of Fujitsu's dynamic role in this exciting area.