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Frontiers of Technology in Microelectronics – Our Activities in Collaboration with Academia

Recent innovation of semiconductor devices and computers is remarkable in terms of memory capacity and CPU speed.

Society has received tremendous benefits from various kinds of electronics over the past 30 years. However, the trouble is that the faster semiconductor devices become, the more energy they consume. We will never overcome the energy consumption problems when we continue to use conventional devices such as CMOS, ECL and HEMT. The development of information technologies such as the Information Highway, that leads to the rapid growth of IT business related to internet, will accelerate this trend.

The development of clean energy generation like solar cells is of course very important, although the total power generation capacity is very small at present. Power saving is one of the most important key technologies to the future of an information and communication age.

One of the essential approaches to overcome power consumption problems of electronics is to develop new electronic devices with low energy consumption and at the same time high switching speed. The various kinds of devices have been demonstrated so far. Some of these candidates are single electron devices and superconducting devices.

We have studied small electron-number devices such as PLEDM (Phase-state Low Electron-number Drive Memory) and Coulomb Blockade devices that make a bridge between conventional semiconductor devices and single electron devices. We have demonstrated the feasibilities of these devices in collaboration with Micro-electronic Research Centre, the University of Cambridge and as one of the members of EU project. Recent development of these devices will be presented in the presentation.

I hope that our small step to overcome energy consumption problems will trigger new challenges to develop low power consumption devices and to maintain sustainable growth of the electronic society in the internet age of the 21st century.