HIRAMOTO-KOBAYASHI LAB.

[Silicon-Based Integrated Devices]

Department of Informatics and Electronics

Integrated Device Engineering – Integrated Nanoelectronics

Department of Electrical Engineering and Information

http://vlsi.iis.u-tokyo.ac.jp
https://nano-lsi.iis.u-tokyo.ac.jp

Towards VLSIs integrating everything

Very large scale integration (VLSI) is the basis of contemporary advanced IT society. Hiramoto/Kobayashi Lab. aims at solving worldwide problems by the technological innovation of future integrated nanoelectronics from the device side. Prof. M. Kobayashi, formerly a researcher in IBM Watson Research working on advanced semiconductor technology, joined the lab in 2014. Based on the vision in Fig. A, we are pursuing the extreme form of integrated nanodevices.

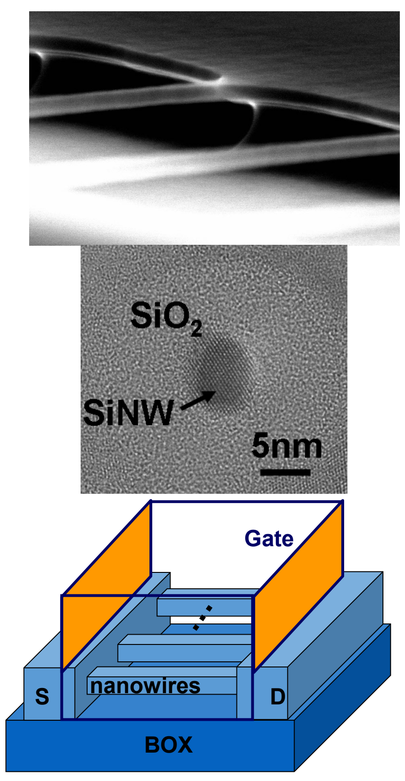


Fig. 1. Silicon nano-wire transistors were fabricated and the quantum effects were evaluated.

Fig. 2. The silicon power device project was initiated. The current density of IGBT was improved by the scaling concept at blocking voltage of 3000V. The double-gate IGBT was also demonstrated.

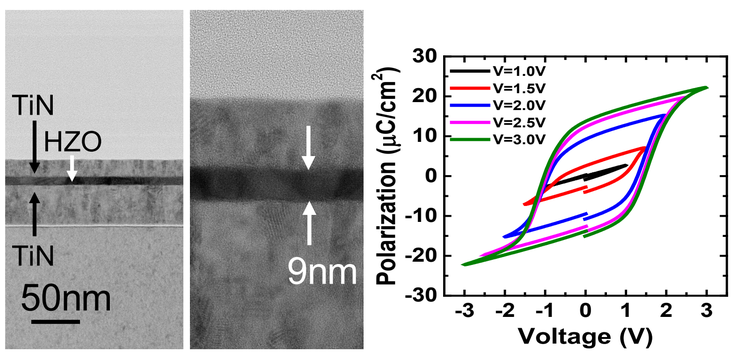


Fig. 3. CMOS-compatible ferroelectric nano film is an enabler for ultralow power logic and memory technology.

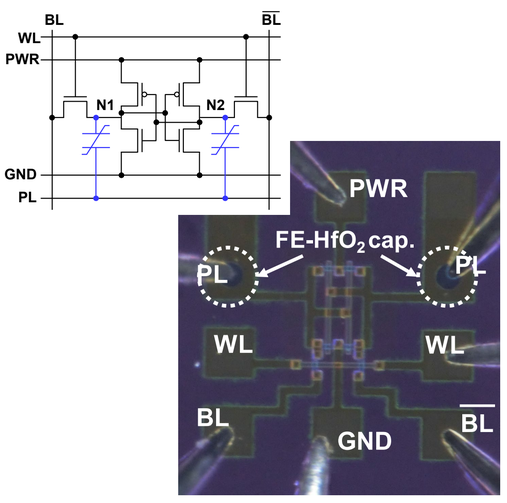


Fig. 4. Nonvolatile SRAM for smart power management.

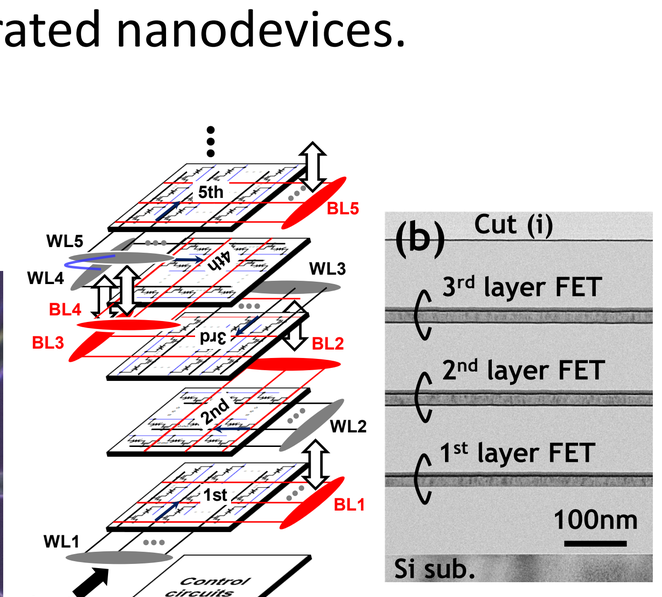
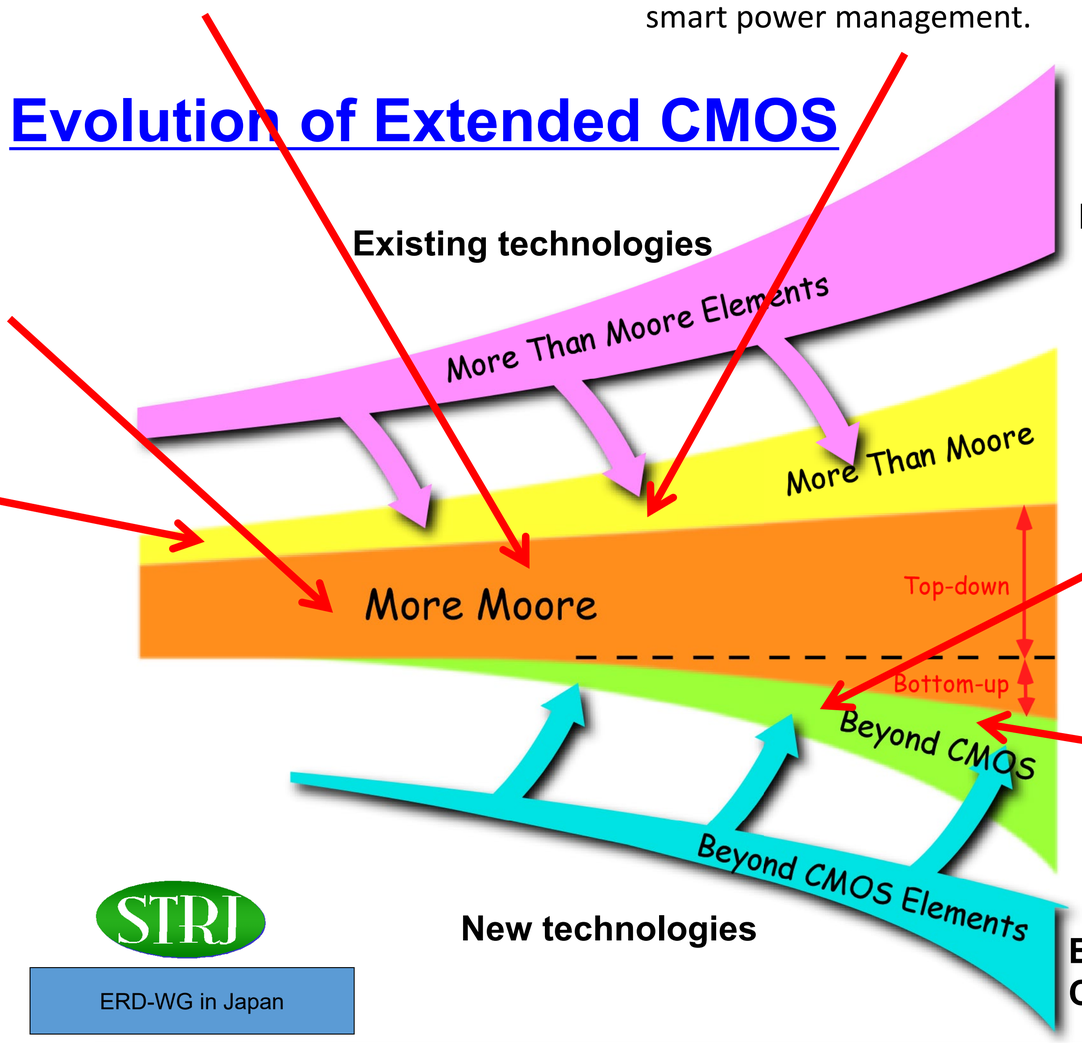


Fig. 5. 3D integration technology by oxide semiconductor IGZO transistor for AI hardware.



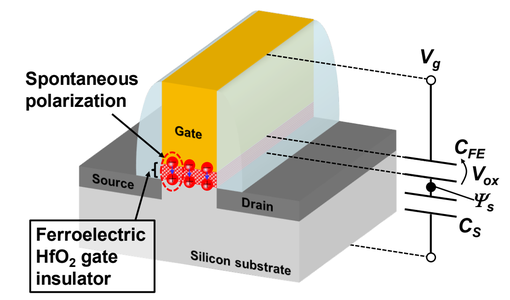


Fig. 6. Negative capacitance transistor can break the physical limit and achieve sub-60mV/dec steep subthreshold slope.

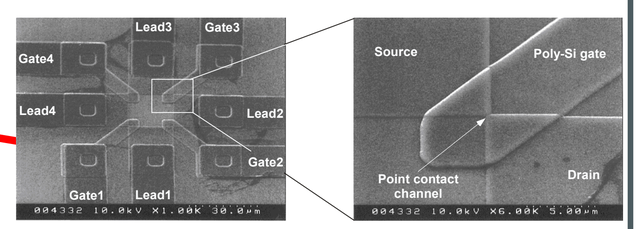


Fig. 7. Single electron transistor, one of Beyond CMOS devices, operating at room temperature is integrated into CMOS, which can be applied to quantum bits for quantum computers.

Fig. A. A vision map of the integrated nanoelectronics, drawn by Prof. Hiramoto in Semiconductor Technology Roadmap Committee of Japan (STRJ). A new field of “Extended CMOS” will be created by integrating “Beyond CMOS” and “More Than Moore” into CMOS base technology. This map is found in International Technology Roadmap for Semiconductor (ITRS).