Session VI “Beyond CMOS technology”

Chair: Hirochika Nakajima (Waseda University)

Co-chair: Atsushi Kurobe (Toshiba), Jun’ichi Sone (NEC)

The session consists of three talks on “Beyond CMOS” architecture and devices. Prof. Hammerstrom (Portland State University) talked about “New system architectures for non Si-MOS”. He touched upon the implementation of biologically inspired model, i.e. neural circuit, in CMOL (Cmos/ Molecular) with Nano-grid architecture. Prof. Someya (The University of Tokyo) presented the exploitation of “Flexible Electronics”, and showed the demonstration of E-skin, pocket scanner, Braille e-paper, and power sheet. The last talk by Prof. Lugli (TU Munich) entitled “Future microelectronics” covered a wide range of topics including organic semiconductor, molecular electronics, carbon nano-tube transistor, Si nano-wire transistor, nano-magnet for Quantum Cellular Automata.

In the discussion part of the session, several important issues are raised by the active audience. It was pointed out and agreed that the learning process of the neural network is important. There was a comment that the neural network computing is slow and that some other biologically inspired architectures may be needed. There were also discussions on the neural computing about how a state is stored, how much the network is tolerant to software bug, and the possibility of implementing emotion into the network architecture.

Power sheet (wireless transmission of electronic power using plastic switches) also attracted many questions and comments. The power transmission coefficient of 80% means a loss of 20%. The origin of the loss is not clear at the moment, but it is probably due to the Joule heating of the metallic coil. There was also a question about the safety of the wireless power transmission. Although it is likely to be safe, more studies are needed to clarify the point.

Inspired by a talk by Dr James Hutchby (SRC) on Thursday about the physical limit of a various switches, there was a question about the minimum energy required for switching using nano-magnets. Prof. Lugli replied that it is about 100kT, and commented two points: One is that the minimum switching energy was derived to assure the stability of nano-magnets at room temperature. The second is that the barrier can be lowered during the adiabatic switching

As was pointed out at the discussion, there are many issues to be addressed in general terms as well. For example, the contact to the device should not be forgotten to compare them with conventional CMOS devices.

The session provided a very good review on the present status of non-CMOS devices. It will be a long way to go before they are in practice, but they can provide an inevitable value to the future integrated systems.