

## **Atomic Switch: From Invention to Practical Use and Future Prospects**

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In the early 2000's, some of the present authors and co-workers invented and developed the atomic switch, which is different from the conventional CMOS transistor switch in the operation principle. Compared to the CMOS transistor, the atomic switch is characterized by: a) non-volatility, b) a small size, c) simple structure, d) low power consumption and e) reasonably high switching speed. More importantly, the atomic switch is highly tolerant not only to electric noise but also radiation. It is our pleasure to report that after about ten years of research in collaboration with NEC Corp, we have achieved the practical use of the atomic switch, in the form of NEC AtomSW-FPGA, which are effectively used in humanoids and space satellites, for example.

In the meantime, we have found that atomic switches with a certain type of structures exhibit interesting characteristics analogous to the synapse of the human brain. Namely, their ON/OFF switching is controlled by the magnitude and frequency of input signals. This characteristic can be used to create novel types of nanodevices with interesting and useful functionalities.

Based on our various experiences in the development of the atomic switch described above, we have developed various nanoionic devices using a solid electrolyte. They are all-solid-state electric-double-layer transistors and related devices to explore novel electronic states of material in a limited nanoscale region.