# Opportunities and Challenges of Atom Switch For Low-power Programmable Logic

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With the increasing complexity of functions in digital circuit, flexibility and energy-efficiency play important roles in addressing future computing systems. Heterogeneous computing architecture using a CPU and a hard-wired programmable unit as an off-loader becomes of great interest for lowering the system power. However, a conventional programmable unit, e.g. FPGA, suffers from its large chip area and power consumption. One solution for overcoming the issues of the conventional FPGAs is a replacement of the conventional switch element composed of SRAM and transmission gate (TMG) to the BEOL devices, for instance, a compact resistive switch having a high on/off current ratio (Fig.1).

Atom switch is an electrochemical resistive-change device categorized in the cation type [1]. The electrochemical phenomenon is based on electrolysis of the Cu electrode to produce a precipitation of Cu at the Ru electrode, which realizing a high ON/OFF current ratio. Previously, we reported a replacement of the SRAM-based switch with atom switch integrated in Cu-BEOL (Fig.2) [2-8]. A reduction of the forming voltage and high ON/OFF-state reliabilities has been realized by introducing a polymer solid-electrolyte (PSE) [2], a complementary atom switch (CAS) [3] and alloy electrodes [8].

In this talk, the developed technologies are reviewed and the opportunities and challenges of the atom switch are discussed especially for low-power programmable logic applications.

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## References

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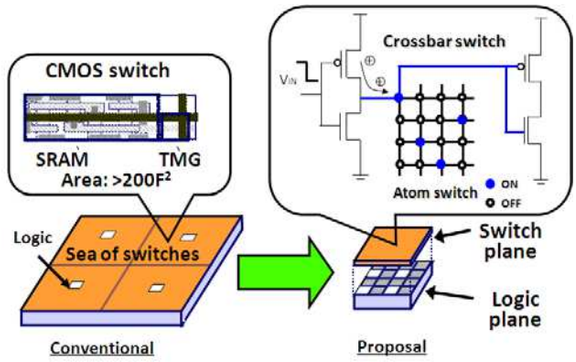


Fig. 1. Schematic image of the introduction of atom switch in FPGA.

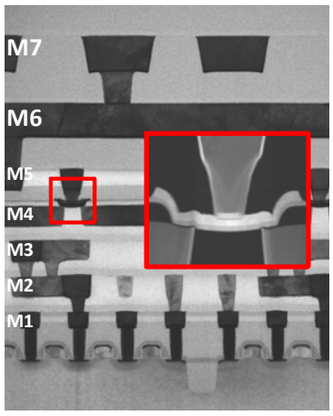


Fig. 2. Cross-sectional TEM image of complementary atom switch (CAS) integrated on a 65 nm-node CMOS [5].