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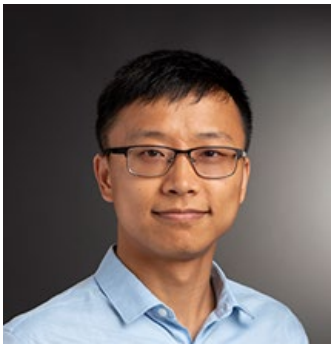
Ferro-Electronics: From Memory to Computing



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Abstract
Research discovery of ferroelectricity in doped hafnium dioxide (HfO2) thin films has triggered tremendous research activities in exploration of ferroelectric memory, especially ferroelectric field effect transistor, for a wide range of applications from low-power logic to embedded non-volatile memory and to processing-in-memory accelerators. This talk will focus on the development of FeFETs towards high-performance and robust embedded nonvolatile memory. Challenges for existing FeFET devices are highlighted and design strategies for mitigation are presented, including the gate stack engineering, back-end-of-line FeFET for monolithic 3D integration, and double gate structure. Following that, important applications of FeFET for processing-in-memory will be presented, including the matrix-vector multiplication accelerator and associative memory. In the last, future research directions, harnessing both ferroelectric and other promising devices, will be presented for both memory and computing applications. Examples include monolithic 3D integration of volatile and nonvolatile memory devices, oscillator based dynamical systems for combinatorial optimization, and extreme environment electronics (e.g., cryogenic).

Bio
Kai Ni received the B.S. degree in Electrical Engineering from University of Science and Technology of China, Hefei, China in 2011, and Ph.D. degree of Electrical Engineering from Vanderbilt University, Nashville, TN, USA in 2016 by working on characterization, modeling, and reliability of III-V MOSFETs. Since then, he became a postdoctoral associate at University of Notre Dame, working on ferroelectric devices for nonvolatile memory and novel computing paradigms. He is now an assistant professor in Electrical & Microelectronic Engineering at Rochester Institute of Technology. He has around 100 publications in top journals and conference proceedings, including Nature Electronics, IEDM, VLSI Symposium, IRPS, EDL, etc. His current interests lie in nanoelectronic devices empowering unconventional computing, domain-specific accelerator, and memory technology

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