

THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT
FALL COLLOQUIUM SERIES PRESENTS:

John E. Dorn Lecture: Susan Trolier-McKinstry

Professor of Ceramic Science and Engineering and Electrical Engineering
Pennsylvania State University



New Materials for Three Dimensional Ferroelectric Microelectronics

In the last decade, there have been major changes in the families of ferroelectric materials available for integration with CMOS electronics. These new materials, including $\text{Hf}_{1-x}\text{Zr}_x\text{O}_2$, $\text{Al}_{1-x}\text{Sc}_x\text{N}$, $\text{Al}_{1-x}\text{B}_x\text{N}$ and $\text{Zn}_{1-x}\text{Mg}_x\text{O}$, offer the possibility of new functionalities. This talk will discuss the possibility of exploiting the 3rd dimension in microelectronics for functions beyond interconnects, enabling 3D *non-von Neumann computer architectures exploiting ferroelectrics for local memory, logic in memory, digital/analog computation, and neuromorphic functionality*. This approach circumvents the end of Moore's law in 2D scaling, while simultaneously overcoming the "von Neumann bottleneck" in moving instructions and data between separate logic and memory circuits. Computing accounts for 5 – 15% of worldwide energy consumption. In the U.S., data centers alone are projected to consume approximately 73 billion kWh in 2020. While recent efficiency gains in hardware have partially mitigated the rising energy consumption of computing, major gains are achievable in a paradigm shift to 3D computing systems, especially those that closely couple memory and logic. The talk will cover the relevant materials, their deposition conditions, and what is known about the wake-up, fatigue, and retention processes.

Susan Trolier-McKinstry is an Evan Pugh University Professor and Steward S. Flaschen Professor of Ceramic Science and Engineering, and Professor of Electrical Engineering. Her main research interests include thin films for dielectric and piezoelectric applications. She directs both the Center for Dielectrics and Piezoelectrics and the Center for Three-Dimensional Ferroelectric Microelectronics. She is a member of the National Academy of Engineering, a fellow of the American Ceramic Society, IEEE, and the Materials Research Society, and an academician of the World Academy of Ceramics. She currently serves as an associate editor for *Applied Physics Letters*. She was 2017 President of the Materials Research Society; previously she served as president of the IEEE Ultrasonics, Ferroelectrics and Frequency Control Society, as well as Keramos.

**Tuesday, October 24 • 4 pm CT • Tech
L211**

In person only; no Zoom

Reception and Refreshments at 5:00 PM CT in Willens Wing Atrium of Tech (2nd floor between B and C wings). The whole MSE Community is welcome to attend!

Questions? Contact allison.macknick@northwestern.edu