1 nm Ferroelectric on Silicon and Application for Energy Efficient Logic and Memory Devices

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Compared to archetypical perovskites, fluorite HfO_2 based ferroelectric materials are process-compatible with advanced CMOS transistors. As a result, they promise to bring ferroelectric technologies into wide-spread applications. At the same time, ferroelectricity in these materials is also different. In conventional perovskites, the polarization becomes weaker as the thickness is decreased due to 'size effects'. Balking this conventional trend, our recent work has shown that ferroelectricity in HfO_2 in fact enhances as the thickness goes down. The ferroelectricity can be demonstrated even in a 1 nm film, which is just two unit cells! In this seminar I shall discuss these results. In addition, I shall also discuss Negative Capacitance transistors with just 18A thick ferroelectric material- the same thickness of high-κ dielectric used in today's advanced transistors. I shall further present ferroelectric tunnel junction results with 1 nm ferroelectric. These results demonstrate that, unlike conventional ferroelectrics, thickness scaling is not a bottleneck for HfO_2 based ferroelectrics, paving the way for their integration in the most advanced logic and memory devices.