- # Anomalous domain switching behaviors in Si:HfO_2 thin film capacitors.

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The HfO_2-based ferroelectric thin films have attracted a great of attention due to their potential applications, such as nonvolatile memories and negative capacitance field effect transistors. Especially, compared to conventional ferroelectrics, the HfO_2-based ferroelectrics have many advantages, including full CMOS compatibility, large bandgap, and very small critical thickness. The operation principle of ferroelectric-based memories is the polarization switching induced by the application of external electric field. Therefore, understanding ferroelectric domain switching dynamics is one of the most important prerequisites for the realization of HfO_2-based memories. In particular, it is highly required to directly observe how ferroelectric domain nucleates and grows at the nanoscale in real capacitor geometry. Here, we present our recent efforts to study ferroelectric domain switching dynamics in Si-doped HfO_2 thin film capacitors using piezoresponse force microscopy (PFM). In most regions, we observed normal domain switching; namely, the domains aligned along the applied electric field by domain nucleation and growth. However, in some regions, the domains aligned against the applied electric field, the-so-called “anomalous domain switching”. Using the stroboscopic PFM imaging and local PFM spectroscopy, we investigated the difference between normal and anomalous domains. We discuss the possible origin of the anomalous domain switching in the Si:HfO_2 capacitors.