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Probing the oxygen vacancy related defect states in HfO_2 gate dielectric using DLTS[1] ARVIND KUMAR, SANDIP MONDAL, KSRK RAO, Indian Inst of Science — Large numbers of theoretical works are present to understand the oxygen vacancy related traps (V_O) in technologically relevant HfO_2. Most of these calculations are based on the atomistic models and typically ideal, hence, cannot provide the realistic device parameters. Here, we applied the Deep Level Transient Spectroscopy (DLTS): a sensitive tool; to study the deep level defects presents in high-k HfO_2. DLTS signal is originating from the segregated oxygen vacancy at the interface, tunneling/hopping between bulk and interface traps and communication of interface defects with respective bands. We observed four prominent deep levels; the estimated activation energies are Ec - 1.22, Ec - 1.36, Ec - 1.76 and Ec - 2.03 eV, below the HfO_2 conduction band. These trap states are related to V_O in different charge states as suggested theoretically. We also measured the capture cross-sections (σ) of these states and found it is quite low (~10^{-18} - 10^{-21} cm^2), which indicate a negligible influence on the device performance. This study will be helpful to disclose the numerous fascinating facts witnessed in HfO_2.

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Arvind Kumar
Indian Inst of Science

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