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Inelastic Tunneling Spectroscopy Study of nm-thick oxides in Metal-Oxide-Semiconductor Structure JINO LEE, KOOKRIN CHAR, Center for Strongly Correlated Materials Research, Dept. of Physics and Astronomy, Seoul National University, SANGJIN HYUN, SANGBOM KANG, SIYOUNG CHOI, Process Development Team, Semiconductor R&D center, Samsung Electronics Co., Ltd.
— Using inelastic electron tunneling spectroscopy (IETS) technique which can probe phonon modes and defect states in the tunneling barrier, we investigated Si(n+) – HfSiO(2.0nm)– Si(p+) MOS capacitor samples. It is an efficient way to study the properties of MOS capacitors because there can be a measurable tunneling current, as the insulating barrier of the MOS devices approaches a few nm. We measured the phonon spectra between 10meV and 70meV and identified each peak using the reference data in previously reported papers by others. When comparing with the data obtained from the sample of Si(n+) – SiO2(1.2nm) – Si(p+) MOS capacitor, we observed the additional intensive phonon mode peak in the HfSiO gate oxide. We believe that this peak is enhanced by interface effects between the substrate and the insulating barrier. In the higher energy regime, features that are associated with the trap-related states were observed. The spatial location relative to the interfaces and the energy level of trap-related states can be estimated through simple modeling, when a same defect state can be identified simultaneously in the forward and backward biases..

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