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Observation of Metal-Insulator Phase Transition of Ce/Si(111): Thickness Dependent Phenomena

Han Gil Lee, Dohyun Lee, Sung-Soo Bae, Sehun Kim and Chanyong Hwang*
Department of Chemistry and School of Molecular Science (BK21)
Korea Advanced Institute of Science and Technology
*Nano-Characterization Group
Korea Research Institute of Standards and Science

The metal-insulator phase transition has been found for the Ce overlayers on Si(111). The existence of insulating phase at a critical coverage (Θ = 4 ML) was clearly observed using x-ray photoelectron spectroscopy (XPS), scanning tunneling microscopy (STM), and scanning tunneling spectroscopy (STS). We observed a huge binding energy shift (about 2.7 eV) in XPS, and the band gap (0.8 eV) in STS at 4 ML. Its origin is still not quite clear, however this can be expected to originate from the localization of Ce layers or the surface relaxation as is the case in Sb on GaAs(110).