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Surface Electronic Excitations of Quantum Confined Mg Films on Si(111)[1] AO TENG, The University of Tennessee and Oak Ridge National Laboratory, KRZYSZTOF KEMPA, Boston College, XIAOGUANG LI, Fudan University, MUSTAFA OZER, The University of Tennessee and Oak Ridge National Laboratory, SABAN HUS, The University of Tennessee, PAUL SNIJDERS, Oak Ridge National Laboratory, GEUNSEOP LEE, Inha University, HANNO WEITERING, The University of Tennessee and Oak Ridge National Laboratory — We have investigated surface electronic excitations at atomically-smooth ultrathin Mg(0001) films on a Si(111)-7x7 substrate using high-resolution electron energy loss spectroscopy. The monopole and multipole surface plasmons of bulk Mg have their counterparts in the thin film regime. The dispersion of the monopole mode, as well as the relative intensity of the multipole mode, exhibit interesting thickness dependencies that are directly associated with quantum size effects in the Mg films. Additionally, we present the first clear observation of a photo-threshold excitation not seen at the surface of bulk Mg. Its intensity is also thickness dependent and anti-correlates with the multipole mode intensity. The results can be modeled with an effective jellium model in which the local Wigner-Seitz radius follows the thickness-dependent variation of the ground-state charge density at the surface. The results are a clear manifestation of quantum-size phenomena in the collective plasmon response of ultrathin metal films.

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