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Plasmon Resonances in Ultrathin Magnesium Films[1] MUSTAFA M. OZER, ORNL Oak Ridge TN, EUN JU MOON, Univ Tennessee Knoxville TN, ADOLFO G. EGUILUZ, HANNO H. WEITERING, Univ Tennessee Knoxville TN & ORNL Oak Ridge TN — Low temperature growth of Mg on Si(111) results in the formation of atomically smooth thin films with precisely controlled film thickness. We employed x-ray photoelectron spectroscopy to monitor the evolution of a sharp shake-up satellite in the Mg 1s core level as a function of the film thickness. For films with thicknesses between five and twenty five atomic layers the energy position of this peak is inversely proportional to the square of the film thickness. These results are consistent with the existence of quantized plasmons, which we interpret on the basis of theoretical (hydrodynamics and RPA) descriptions of the density-response function. We demonstrate that the observed loss feature corresponds to the n = 1 antisymmetric normal mode of the thin film, consistent with the fact that in the ultrathin film limit the symmetric plasmons have vanishing spectral weight - a striking manifestation of the role of size quantization on plasmon resonances in precisely controlled nanostructures.

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