PHOTOABSORPTION OF Ag (N = 6 - 6000) CLUSTERS IN He DROPLETS: A TRANSITION FROM SINGLE- TO MULTI-CENTERED GROWTH

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Ag clusters with up to thousands of atoms were grown in large He droplets and studied by optical spectroscopy. For clusters smaller than about 10^3 the spectra are dominated by a surface plasmon resonance near 3.8 eV and a broad feature in the UV, consistent with the absorption of individual metallic particles. Larger Ag clusters reveal an unexpectedly strong, broad absorption extending to lower frequencies down to approximately 0.5 eV. This suggests a transition from single-center to multi-center formation, in agreement with estimates of the kinetics of Ag cluster growth in He droplets. Moreover, the spectra of large clusters develop a characteristic dispersion profile at 3.54.5 eV, indicative of the coexistence of localized and delocalized electronic excitations in composite clusters, as predicted theoretically. We also report on the characterization of He droplet beams, obtained in the supercritical expansion regime, comprised of large droplets of up to 10^{11} atoms.