ULTRAFAST SPECTROSCOPY OF TRANSITION METAL NANORODS

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Nanorods composed of transition metals were fabricated and studied by ultrafast transient absorption and static UV vis-NIR spectroscopy. Platinum, iron, cobalt, silver and rhodium high-aspect ratio nanorods were made by electrodeposition in 6 μm thick, polycarbonate templates. The nanorods were produced with aqueous plating solutions in templates with nominal pore sizes of 10 and 30 nm, resulting in rods with 40 and 60 nm diameters as indicated by SEM measurements. Aluminum nanorods, which cannot be electrodeposited using aqueous solutions, were fabricated in an ionic liquid-based Al plating solution. Transmission spectra show that the nanorods of each metal have a transverse surface plasmon resonance band in the 400-600 nm range and a longitudinal band in the mid-infrared. Ultrafast transient absorption measurement with 400 nm pump and 800 nm probe are used to characterize electron-phonon coupling times and coherent acoustic breathing mode oscillations. The oscillations occur on a 10-40 ps timescale and are consistent with classical expectations for acoustic breathing mode periods based on the nanorod diameters and the bulk longitudinal speed of sound for each metal. Results are consistent with those previously reported for other metals (gold, nickel, and palladium).(1) Furthermore, the dynamics for these metals are similar to those observed for smaller nanoparticles and nanorods.

(1) G.M. Sando, A.D. Berry, and J.C. Owrutsky J. Chem. Phys. 127(7), 074705 August 2007