"Single Particle Plasmonic Nanospectroscopy"

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Physicochemical properties of nanoparticles may depend on their size and shape and are traditionally assessed in ensemble-level experiments, which accordingly may be plagued by averaging effects. These effects can be eliminated in single-nanoparticle experiments. Plasmonic nanospectroscopy, an optical experimental technique that exploits plasmonic nanoantennas as nanoscale optical sensors, is an experimental approach that facilitates the in situ study of individual nanoparticles using benchtop equipment. In this talk I will present a comprehensive plasmonic nanospectroscopy study of hydride formation thermodynamics in individual Pd nanocrystals of different size and shape, for which we find corresponding enthalpies and entropies to be nearly size- and shape-independent. [1] At the same time, the hysteresis observed is significantly wider than in bulk, with details depending on the specifics of individual nanoparticles. Generally, the absorption branch of the hysteresis loop is size-dependent in the sub-30 nm regime, while desorption is size- and shape-independent. The former is consistent with a coherent phase transition during hydride formation, influenced kinetically by the specifics of nucleation, whereas the latter implies that hydride decomposition either occurs incoherently or via different kinetic pathways.

[1] Syrenova, S. et al. Nature Materials, 14, 1236–1244 (2015).