Critical need: High-throughput methods for screening single-nanocrystal properties

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This presentation will outline the critical need for high-throughput tools and methods that screen single-nanocrystal properties. Colloidally prepared nanocrystals present a variety of different features (e.g., planes, edges, and defects), and the distribution of these features will vary from one nanocrystal to the next even in the best nanocrystal samples. Given the strong structural dependence of many nanocrystal properties, such heterogeneity is a double-edged sword. On the one hand, this heterogeneity provides ample opportunity to discover new structures with useful properties. On the other hand, this heterogeneity makes structure-property correlation challenging as common property measurements (e.g., by absorption spectroscopy, cyclic voltammetry) are based on the ensemble, meaning that each nanocrystal may contribute by a different (unknown) amount. This heterogeneity likely affects the performance of nanocrystals samples for a broad range of applications where important minority features may be hidden. To identify and ultimately leverage this heterogeneity, high-throughput tools and methods that screen the properties of nanocrystals at the single-particle level are needed. Advances developed by the Center for Single-Entity Nanochemistry and Nanocrystal Design will be discussed. These advances include a new high-throughput electrochemistry platform consisting of 96 electrochemical cells dimensioned to match common 96-well plates, which is compatible with electroanalysis and electrosynthesis of metal nanocrystals. These advances also include the application of calcite-assisted localization and kinetics (CLocK) microscopy to metal nanocrystals, with CLocK images encoding spectral data that can be used to extract nanocrystal size and orientation rapidly and accurately, without the need for electron microscopy.