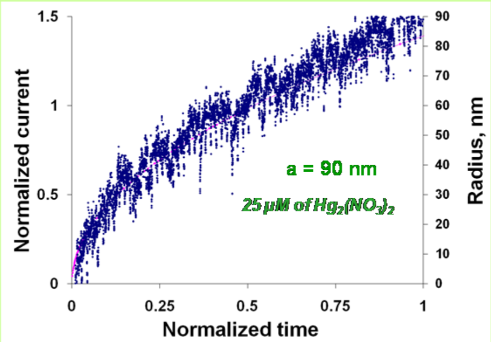
How Many Metal Atoms Can Act as a Catalyst?

Michael V. Mirkin, Department of Chemistry, Queens College - CUNY

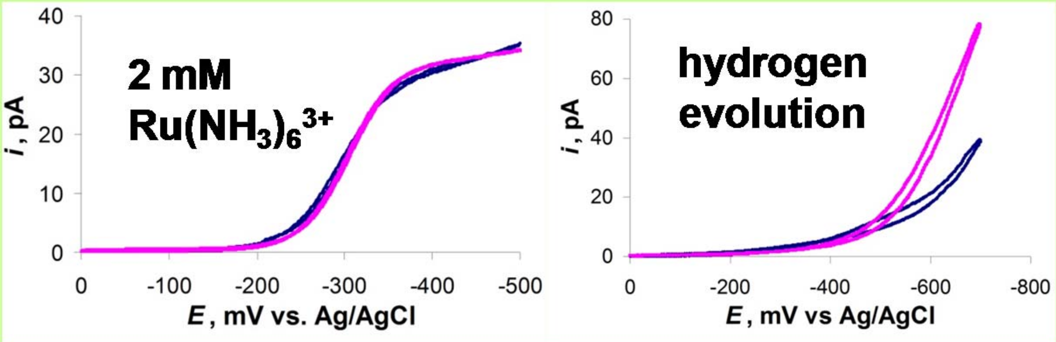
Nucleation/growth of metals on nanoelectrodes

Using nanoelectrochemical approaches, we were able to monitor the formation and growth of nanometer-sized single metal nuclei. Our experiments revealed the possibility of a yet unknown mechanism of the initial stages of electrodeposition that became accessible due to very low number of active nucleation sites on the nanoelectrode surface.

We developed methodology for preparation of nanometer-sized electrocatalytic clusters by electrodeposition o metals at nanoelectrodes. A patch clump amplifier employed in our experimental setup allows measurements of pA-range currents on a microsecond time, which would not be possible with conventional electrochemical instrumentation.



Growth of a Hg nucleus on a 90 nm Pt electrode. Experimental current transient (symbols) is fitted to the theory (solid line).



Electrodeposition of a small Pt cluster at a 65 nm Au electrode. The voltammograms of $Ru(NH_3)_6^{3+}$ obtained before (blue) and after (pink) the deposition are essentially identical (A), but hydrogen evolution voltammetry shows the formation of a Pt cluster (B).