Characterization and modification of nanometer-sized electrode

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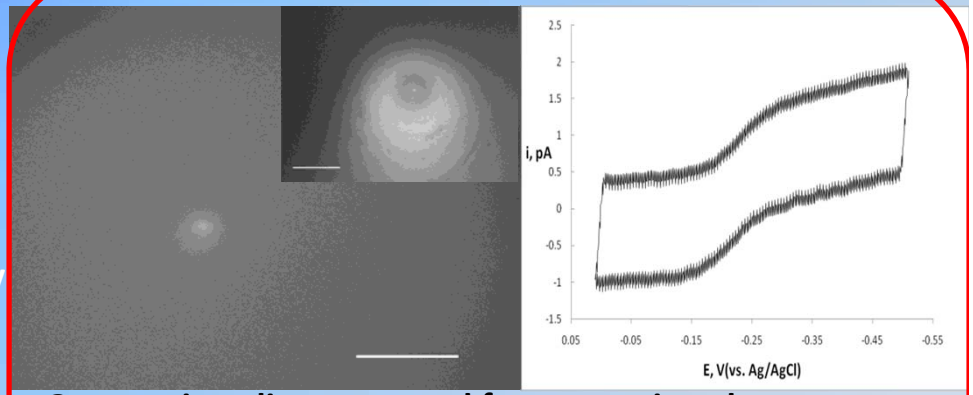
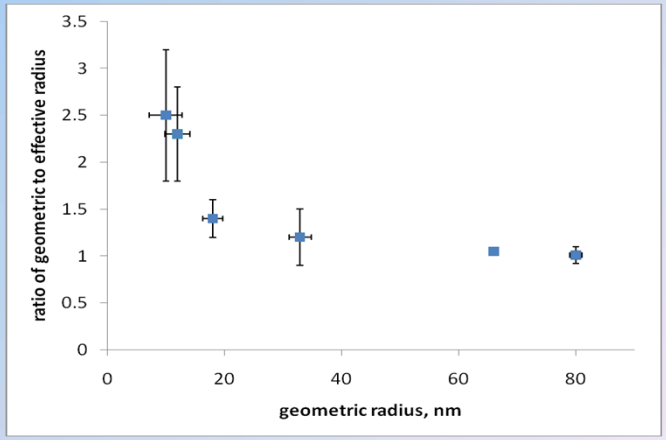
Our goal of the proposed research is to study the charge transfer across the interface between a small aqueous (or organic) phase and a bulk organic (or aqueous) phase. To achieve this goal, it is necessary to use a nanometer-sized electrode so as to study the reaction in a small phase whose volume is less than 1 femto-liter.

At the moment, we concentrated on the study of the electrochemical properties and the surface modification of very small electrode, because it is fundamentally and experimentally important to understand the stability of the very small droplet on the electrode. We found annealing is a very important step in preparing a well polished puller-made nanometer-sized electrode with a radius larger than 10nm. For a well polished nanometer-sized electrode with an effective radius (measured from cyclic voltammogram) larger than 20nm, the effective radius is almost equal to its geometric radius (measured from scanning electron microscope). A relatively big difference between the effective and the geometric electrode radii can be observed when the effective electrode radius is smaller than 20nm. Cyclic voltammograms show that there is apparent current fluctuation on a 1.6nm radius electrode at slow scan rate. The current fluctuation may result from the potential fluctuation at the electrode/solution interface or the electric double layer effect.



Geometric radius measured from scanning electron microscopy images is 12.5±2.1nm. Effective electrode radius measured from cyclicvoltammogram is 5.4±0.7nm.



Plot of ratio of geometric to effective radius over the geometric radius of nanometer-sized electrodes.