From Surface Enhanced Spectroscopy to Electrochemistry: Surface Plasmon Resonance Enhanced Photoluminescence and Electrochemistry of DNA Modified Electrode

Surface plasmon resonance of metallic nanoparticles has attracted much attention in the past few decades due to its tremendous impact on many photo-chemical and photo-physical processes of molecules. Many important applications including molecular sensing, catalysis, nanolithography and near field optical microscopy utilize the phenomenon. We investigated the influence of surface plasmon resonance of nanotextured silver films on the radiative decay processes of molecular systems. The photoluminescence intensity of dye molecules was enhanced more than an order of magnitude under certain circumstances and we used a photophysical model to interpret the enhancement in terms of absorption enhancement and increased radiative decay rate caused by molecule-plasmon interactions. The molecule-metal distance dependence of photoluminescence enhancement and the spectral changes of molecular emission and excitation spectra caused by the interaction with metallic nanoparticles will be discussed. Preliminary data show that photoluminescence enhancement can be applied to electrogenerated light-emitting system (e.g., organic light emitting diode and electrogenerated chemiluminescence or ECL) and photovoltaic cells (e.g., organic photovoltaic cell and photoelectrochemical cell).

The second part of my talk will focus on AC impedance of DNA modified electrode and enhanced voltammetric behavior of ferrocene-DNA conjugated with Gold nanoparticle. Gold nanoparticle was found to be able to enhance the cyclic voltammetric behavior and improve signal to noise ratio of ferrocene electrochemical reaction when being used as electroactive indicator of DNA sensing. Apparent ferrocene molecular density for each DNA bonding event can be enhanced 100 folds, and heterogeneous self-exchanging rate constant, which facilitates efficient charge transfer into DNA coated gold electrode under the mediation of gold nanoparticle is measured.

Finally, single nanoparticle electrochemistry aiming at single molecule/single particle detection will be introduced briefly.