549e Manipulation of the Electrode/Electrolyte Interface of Gold Via the Application of an External Electric Field

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The behavior of the electrical double layer (EDL) associated to electrodes is critical to many electrochemical processes. Although electrodes like gold and platinum are believed to be "inert", specific interactions of the electrodes with hydroxyl groups, protons, halide ions, and organic molecules present in solution have been reported. The extension of adsorption, surface coverage, and even structure of the adsorbed layer of different molecules are highly dependent on the applied potential on the electrode. Furthermore, the nature of the interaction of the solvent molecules with the electrode surface is highly dependent on electrode potential as well. Externally applied potentials are employed in this work in order to assess the change in the electrode/electrolyte interface of a gold electrode at a wide range of pH and sodium chloride concentrations (ionic strength). This is done through the determination of the surface potential corresponding to a specific value of applied potential. Since no relationship can be readily established between the surface potential and the applied potential, a model based on a non-linear analytical solution of the Poisson-Boltzmann (PB) equation is used to adjust predicted force values and direct force measurements between a gold electrode and a silicon nitride tip obtained by atomic force microscopy (AFM). It is demonstrated that the application of an electric field can change the direction, range, and strength of the interaction forces, and that these changes are closely related to the chemical conditions in the system.