E-ALD of Pd on Au Single Crystals

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Studies of the adsorption and absorption of hydrogen on nanofilms of Pd formed on Au substrates will be discussed. The electrochemical analog of atomic layer deposition (ALD), E-ALD, has been used to form films 0.5 ML to 50 ML thickness. The chemistry used to form the films will be briefly described. The thinner films allowed characterization of the hydrogen waves on Pd, with minimal interference from the adsorption process. To better characterize the dependence of the hydrogen waves as a function of surface structure, single crystal Au substrates have been used to grow the Pd films. It is evident from these studies that the adsorption of hydrogen is strongly dependent on the surface structure and history of the electrode. Scanning tunneling images were collected in-situ during several cycles of surface limited redox replacement (SLRR), used to grow the film. Those results support the layer by layer growth model.

In addition, modification of the kinetics for hydrogen absorption are being investigated. The premise is that adsorbed hydrogen is the transition state to hydrogen absorption into Pd. By modification of the adsorption energy, hydrogen absorption and desorption rates can be modified. Some preliminary results concerning this topic will be described.