

A model of hydrogen interaction with palladium tested by EIS.

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Palladium may be used as a model of hydrogen absorbing material for understanding the metal hydride system. The aim of this study is to determine the kinetic parameters of reactions involving hydrogen on thin films of palladium and their evolution as a function of applied potential and film thickness [1, 2, 3]. The understanding of the phenomena related to hydrogen at the palladium/solution interface is very important as they are involved in various domains as corrosion, catalysis or fuel cells.

Electrochemical impedance spectroscopy (EIS) was used to study the kinetics of adsorption and absorption of hydrogen on electrodeposited palladium layers in the potential range of stability of the α and β -PdH phases. In the α phase only hydrogen absorption in the metal occurs without hydrogen evolution. Figure 1 shows the impedance measured in the α phase region for a 250 nm thick palladium film immersed in 0.1 M H_2SO_4 . The impedance diagram is formed by a high frequency capacitive loop due to the charge transfer resistance in parallel on the double layer capacity followed in the lower frequency range by a capacitive straight line related to the ion-blocking behaviour of the electrode.

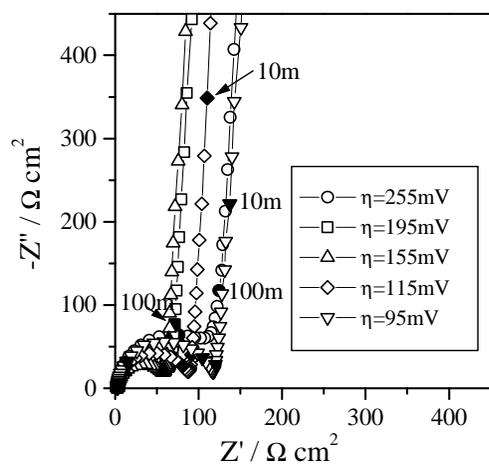


Figure 1 : Electrochemical impedance measured on a 250 nm palladium deposit in 0.1 M H_2SO_4 ,

Figure 2 shows the variation of the charge transfer resistance with respect to potential for various thicknesses of the palladium layer. R_{ct} changes with the thickness of the layer, which is surprising as, usually, this quantity is only surface dependant.

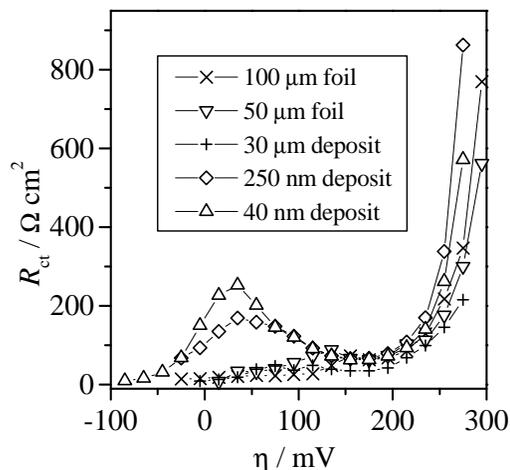


Figure 2 : Variation of the charge transfer resistance with respect to potential for various thicknesses of the palladium layer.

Based on the concept of hydrogen trapping and direct hydrogen desorption from the host palladium a model is proposed to explain the experimental results [4]. The predicted impedance is in agreement with the experimental results and, in particular, the charge transfer resistance is thickness dependant (Figure 3).

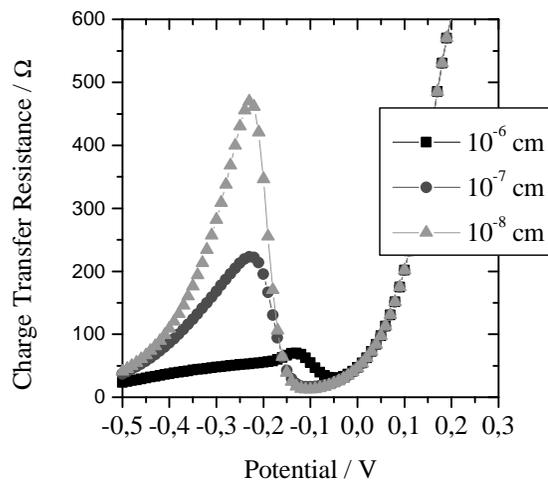


Figure 2 : Calculated variation of the charge transfer resistance with respect to potential for various thicknesses of the palladium layer.

References

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