Kinetics of hydrogen desorption from palladium and ruthenium-palladium foils

A. L. Cabrera, Erie Morales and J. N. Armor

Abstract

The absorption of hydrogen and carbon monoxide at room temperature by palladium and 5% ruthenium-palladium foils was studied using thermal desorption spectroscopy. It was found that hydrogen readily diffused in the palladium and desorbed as one broad peak at about 650 K. Plots of the In (rate) versus inverse absolute temperature indicate that the desorption order is n = 1.25 and the activation energy is about 8.5 Kcal/mol. Carbon monoxide is adsorbed, as two different states, on the surface of the foil and complete coverage is quickly reached below 100 L. Hydrogen also diffuses in 5% ruthenium-palladium foil but to a lesser degree. Two hydrogen desorption peaks are observed in the Ru-Pd alloy. The desorption traces can be fitted with two peaks and the desorption orders are n = 2 for the first peak and n = 1.25 for the second peak. Activation energies of 10.7 and 5.6 Kcal/mol are obtained for the first and second hydrogen peaks, respectively. The first hydrogen desorption peak is regarded as hydrogen desorbing from the surface sites while the second peak is regarded as hydrogen diffusing from below the surface. Activation energies for bulk diffusion were obtained from hydrogen uptake measurements using a sensitive microbalance. These energies corresponded to 4.4 Kcal/mol for Pd foil and 4.9 Kcal/mol for the Ru-Pd alloy. Discussion about the relation between these results with prior studies of hydrogen adsorption on Pd single crystal is included. The appearance of a fractional order for hydrogen desorption is also discussed.