Changes in crystallographic orientation of thin foils of palladium and palladium alloys after the absorption of hydrogen

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Abstract

The adsorption/absorption of hydrogen at room temperature by palladium, 16% silver-palladium and 5% ruthenium-palladium foils was studied using thermal desorption spectroscopy. Hydrogen readily diffused in the palladium and desorbed as one broad peak at about 650 K. Hydrogen also diffuses in the 16% silver-palladium foil and in the 5% ruthenium-palladium foil but with a smaller diffusion constant. Two hydrogen desorption peaks are observed for the Ru-Pd and Ag-Pd alloys, at 440 and around 650 K. The first hydrogen desorption peak is regarded as hydrogen desorbing from the surface sites while the second peak is regarded as hydrogen diffusing from the subsurface sites. The desorption order for surface hydrogen corresponds to $n = 2$ while the diffused hydrogen desorbs with a fractional order of $n = 1.25$. The crystallographic orientation of the foils determined by X-ray diffraction shows a preferential (1,1,0) orientation along the direction of rolling of the foils before hydrogen absorption. This preferential orientation is destroyed after hydrogen adsorption for Pd and Pd-Ag but unaltered for the Pd-Ru alloy. This preferential orientation of the foils might have significant implications in membrane fabrication, since the absorption of hydrogen by Pd is very dependent on surface orientation.