INFLUENCE OF TEMPERATURE AND ALLOY BULK COMPOSITION
ON HYDROGEN ELECTROSORPTION INTO PALLADIUM-RHODIUM ALLOYS

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Introduction
Palladium-rhodium alloys are an important model systems for understanding the process of hydrogen sorption in metallic systems. In general, the addition of a second noble metal to palladium decreases the amount of absorbed hydrogen. Pd-Rh alloys are exceptional systems because the amount of absorbed hydrogen in Pd-rich Pd-Rh alloys is larger than in case of pure Pd. Thus an accurate examination of Pd-Rh systems is very important considering alloys application for the hydrogen storage.

Experimental
Hydrogen electrosorption into Pd-Rh alloys was studied in acidic solution (0.5 M H$_2$SO$_4$) using cyclic voltammetry and chronoamperometry. Platinum gauze was used as the auxiliary electrode and Hg|Hg$_2$SO$_4$|0.5 M H$_2$SO$_4$ was used as the reference electrode. Alloys were obtained by electrodeposition from baths containing PdCl$_2$, RhCl$_3$ and HCl. Thin films (= 1 μm) of Pd and its alloys were deposited as limited volume electrodes (LVEs) on a gold wire (Fig. 1.). Alloys with various content were prepared by changing i) the potential of the deposition and ii) concentrations of the chlorides in baths.

Results and Discussion
Hydrogen Absorption Capacity
The influence of temperature (in the range between 283 K and 328 K) and alloy bulk composition on parameters of hydrogen sorption in Pd-Rh alloys was examined. It has been found that for the temperature range studied the maximum hydrogen absorption capacity is the highest in 283 K and decreases with temperature increase (Fig. 2.). An alloy containing 92.6% at. Pd is characterized by the highest hydrogen absorption capacity with H/M ratio exceeding 0.80 at 298 K.

Enthalpy of the Hydride Formation and Decomposition
Fig. 3. shows that the ΔH$_{a→β}$ value increases with Rh content, thus the process of hydride formation is less exothermic than in pure Pd. Whereas, ΔH$_{β→a}$ value decreases with Rh content, therefore the process of hydride decomposition in comparison with pure Pd is more exothermic. In regards to the values of enthalpy of hydride formation and decomposition obtained by Flanagan and Luo [1] (FL in the legend), our results are in good agreement.

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