Hydrogen electrosorption into palladium-nitrogen alloys.

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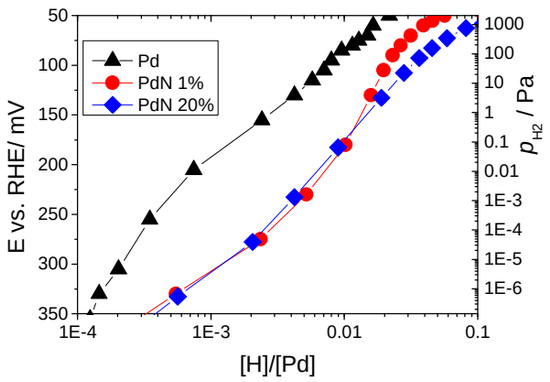
The majority of studies on hydrogen absorption focus on metallic elements with much less emphasis on hydrogen interactions with non-metallic elements. Nonetheless, structural and thermodynamic properties of these alloys are of considerable fundamental and technological importance, e.g. in semiconductor technology and catalysis.

In this study Pd–N alloys were prepared by ion implementation of nitrogen into electrodeposited palladium thin layers (50-200nm) deposited on gold substrates prior to implementation. The nonmetallic element content in these alloys varied from 0.1 to 20 at. % depending on experimental conditions. Structure of prepared PdN films was investigated by using Grazing Incidence X-ray Diffraction (GIXD). This method allowed us to get insight in depth-resolved material structure. After nitrogen implementation we observed diffraction lines from solid nitrogen embedded into palladium structure most likely in form of nanoparticles.

The studies of hydrogen absorption in those alloys were carried out using classical transient measurements and electrochemical impedance spectroscopy. The hydrogen insertion into the alloy was performed in an aqueous 0.1 M HClO4 solution and electrosorption isotherms were then determined. The results indicate that although the total amount of the hydrogen dissolved in those alloys decreased with the increase of nonmetallic element content, the hydrogen insertion in the alpa-phase was significantly higher for alloys than for pure palladium (Figure 1).



Hydrogen pressure–composition (PC) obtained electrochemically in 0.1M $HClO_4$ for pure palladium and Pd-N electrodes.