Silver-Palladium mesowires for the extended detection of H_2

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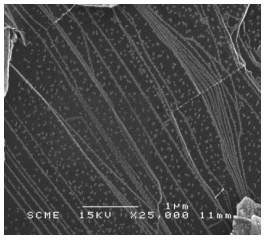
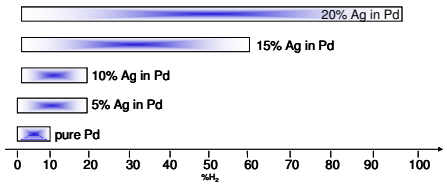
The decreasing oil resources and the need for environmental friendly alternative energy sources have raised the importance of hydrogen as a fuel for future energy. The safety issues associated to the use of hydrogen have motivated the research in reliable H2 sensors.
The vast majority of these safety sensors includes palladium in the composition of the sensing part. This comes from the reversible formation of palladium hybrid when Pd is in presence of H2 at room temperature and low pressure. Detection is based on the variation of physico-chemical properties (mass, volume, refraction index and especially conductivity) undergoing the hybrid formation. These sensors are highly selective and sensitive (down to few H2 ppm) but full signal is usually reached at low H2 concentration (10%H2). These devices are suitable for safety purposes but demand also lies on H2 sensors for other technological uses including real-time quantitative analysis of hydrogenated mixtures in gas flows, hydrogen purification or dehydrogenation of organic compounds. For such applications, full range H2 sensors seem necessary. In such sensors, sensitive material has to show a higher H2 solubility than palladium.
It has been suggested that higher solubilities of H2 can be achieved by alloying palladium with other metals such as Ag or Au[1].
Few years ago, the first fabrication of H2 sensors based on Pd mesowires electrodeposited on Highly Oriented Pyrolytic Graphite was reported[2]. Performances have been attractive: high selectivity, fast response, room-temperature operation and a proportionnal signal response from 0.5 to 10%H2 in air.
The present work exposes the way we expend the detection range of Pd mesowire based sensors by alloying palladium and silver in various contents. Sensing mechanism and performances are discussed on the basis of structural informations from in-situ X-ray diffraction data under controlled hydrogenated atmospheres.





[1] H. Amandusson, L.-G. Ekedahl, H. Dannetun, J. Membr. Sci. 193 (2001) 35.
[2]F. Favier, E.C. Walter, M.P. Zach, T. Benter, R.M. Penner, Science 293 (2001) 2227.