

Enhancing Sensitivity of SAW Sensors using Nanostructured Materials

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Introduction

Pd Nanoparticles and nanowires have been fabricated for use as the sensing element in Hydrogen gas sensors. These nanostructures being one-dimensional, have a large surface to volume ratio. This allows for higher sensitivity and faster response times due to the large adsorption surface and smaller diffusion lengths. Palladium has been chosen as the sensing material for these nano-structures for hydrogen sensing applications due to its property of absorbing hydrogen- up to 900 times its own volume. The nanoparticles and nanowires were electrodeposited on a highly oriented pyrolytic graphite surface [1], at different potentials. The effect of change in morphology on sensors was recorded.

Nano-structures as the Sensing Element

We have developed the use of nanowires and nanoparticles as the sensing element in the fabrication of surface acoustic wave devices (figure 3). Surface Acoustic Wave (SAW) sensor systems have been developed for gas detection and identification for some time. Coating the SAW devices with different nanostructured materials that selectively absorb different gases allows significantly faster gas detection by changes in SAW frequency. The technology can be used for arrays of coated SAW devices that detect different gas molecules such as hydrogen, carbon oxides, nitrous oxides, hydrocarbons, water vapor, and sulfur oxides. Surface wave velocity variations that result from the faster absorption of a specific gas species can be detected as either phase shifts or as frequency shifts.

Results

Nanoparticles and nanowires were fabricated from aqueous 2.0 mM Pd(NO₃)₂, 0.1 M HClO₄. The scanning electron micrographs of figures 1 and 2 on the right show agglomeration of palladium nanoparticles. Figure 2 also shows the deposition of the nanowire on step edges of a hopg (highly oriented graphite surface). The size of the nano-particles can be controlled and is in the range of 10 nm to a few hundred nm.

References

[1] Penner, R.M. et.al. *Palladium Mesowire Arrays for Fast Hydrogen Sensors and Hydrogen- Actuated Switches* 2002 Anal.Chem. 74, 1546-1553.

Figure 1; SEM image of Pd agglomeration at 30K magnification.

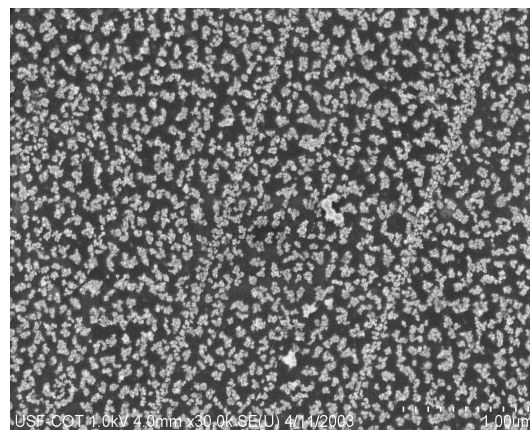


Figure 2; SEM image of Pd agglomeration at 15 K magnification

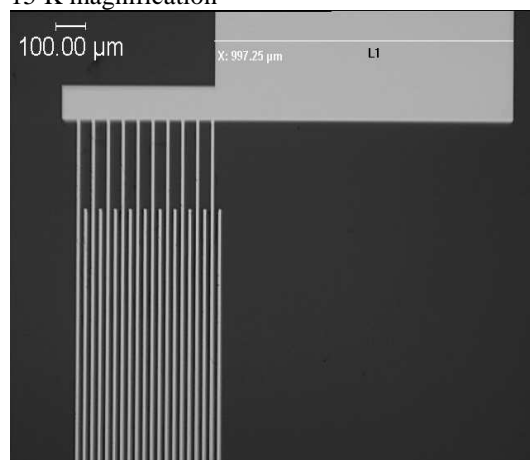


Figure 3; Lithium niobate SAW via optical lithography

