Nanoporous film containing Pd nanograins growth on silicon covered with DLC layer

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Summary: In this paper we present studies of structural properties of C-Pd thin films obtained by RFPECVD/PVD/CVD method. The results of SEM and AFM studies for films prepared on Si (n- and p-type) substrates are presented.

Keywords: carbonaceous-palladium films, DLC films, RFPECVD/PVD/CVD method

Introduction

Films containing palladium can be applied in hydrogen and hydrogen compounds sensors. The size of palladium grains and their distribution on the film surface affect on the sensitivity of such film and their ability of hydrogen dissolution in palladium.

We prepared nanoporous carbon films containing palladium nano-grains (nC-Pd films) for hydrogen sensor application. The influence of technological parameters of each step of technological process on the form of obtained film is a subject of this presentation.

Results

The nC-Pd film was prepared in a following way: first diamond-like carbon (DLC) film was deposited on the Si substrate by radio frequency plasma enhanced chemical vapor deposition method (RFPECVD); then physical vapor deposition (PVD) process was applied to obtain nanocomposite carbonaceous film (NC film) with palladium nanocrystals dispersed in all the volume of film; at last chemical vapor deposition (CVD) method in assistance of xylene and argon at the temperature 650°C was used for obtaining nC-Pd film. In this paper we will discuss the influence of technological parameters of each of the processes on the superficial properties of prepared films.

We found that NC films obtained on Si substrate have lower roughness than film deposited on Si substrate covered with DLC layer. After CVD modification the roughness increases and big palladium grains are found on the film surface. Prepared NC films and final nC-Pd films are presented in Fig.1a and Fig.1b respectively. White object in Fig.1a are fullerite nanocrystals and observed dark areas posses lower palladium content than bright areas.

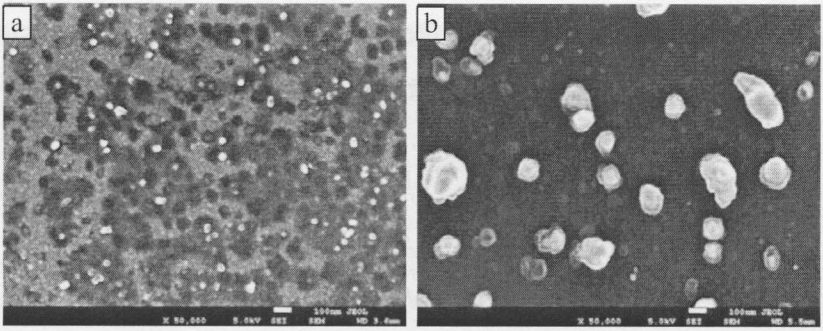

Fig.1. Microstructure of a) NC films and b) final nc-Pd films

Presented above images films show that after last technological process films characterizes with 1) a highly developed surface, 2) Pd nanograins with size up to hundred nm placed on the film surface, 3) Pd nanograins in a carbon shells. Such changes of an active area topography and morphology of film influence on the its sensitivity toward hydrogen.

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