CAR-01

Catalytic degradation of carbonaceous – palladium film by laser beam

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INTRODUCTION

During last 20 years many forms of carbon were discovered (nanoonions, carbonaceous foam nanocrystalline carbon). Variety form of carbon structures is the result of different kind of a hybridisation. Carbon - palladium systems lead to a formation of nanoporous structure in which palladium nanocrystals are placed [1]. Such material systems are interesting because of theoretical and practical point of view. For example an optical sensor or switch could be produce with this material. It is widely known that palladium reacts with hydrogen forming palladium hydride [2]. Molecular structure of initial film is very important factor affecting on the final film form after gas adsorption/ absorption process. We presents results of TEM and Raman studies of a molecular structure of C-Pd nonstructural films. Technology of preparation C-Pd film is described in [1].

SAMPLE PREPARATION

Physical Vapor Deposition Method (PVD)

Fig.1a Technological equipment –PVD process

Table 1 List of the sample

Sample number	Substrates
164PVD	silicon
241PVD	quartz
296VD	Mo

These films were obtained by PVD (Physical Vapor Deposition) method from two separated sources was used: one source contained fullerene C_{60} and second contained palladium acetate $Pd(C_2H_3O_2)_2$. Depending on kind of substrates, temperature of sources, the rate of growth of nanostructures the film obtained by PVD was composed of a carbonaceous matrix and Pd grains placed in it. Samples were studied with TEM and Raman spectroscopy.

EXPERIMENTAL

Investigated films were irradiated by focused laser beam (532nm) and different beam power density (0.5 – 50 kW/mm^2). Raman spectra were collected twice: during irradiation using excitation power density the same as irradiation power density (1st process) and after irradiation using small power density 0.5mW/mm^{2k} (2nd process).

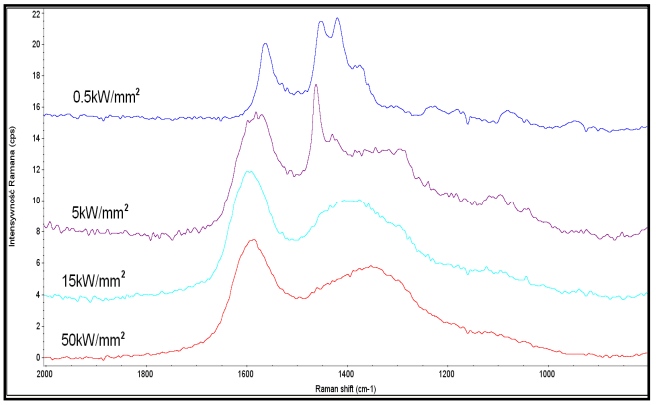

Fig.2. Raman spectra collected during irradiation using different power density

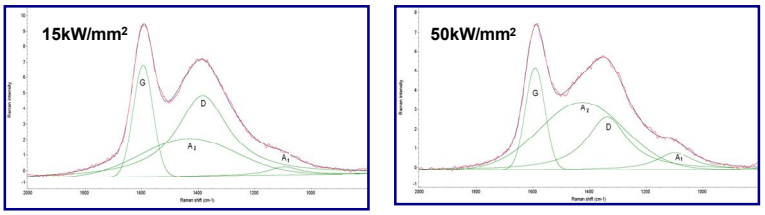

Fig. 3. Decomposition of the spectra collected from different irradiated areas.

Band	15kW/mm^2			50kW/mm^2		
	Peak type	ω [cm^{-1}]	FWHM	Peak type	ω [cm^{-1}]	FWHM
A_1	Lorentzian	1095.938	127.724	Lorentzian	1098.138	154.900
D	Lorentzian	1384.163	217.568	Lorentzian	1338.290	176.748
A_2	Gaussian	1432.462	391.721	Gaussian	1427.197	354.310
G	Gaussian	1595.305	82.034	Gaussian	1593.085	81.117

Changes of film's structure were deduced from Raman spectra and Raman microscopy images obtained for area of interaction with laser beam. We found that fullerenes characteristic band (1467,5 cm^{-1} [3]) disappeared due to this interaction. This band intensity quickly decreases with the laser beam power density increase. On the other hand D- and G –bands, characteristic for graphite – like structure [4], were created and their intensity have been increased. It was found that an area of graphitization was about 3-4 nm. Changes of the width and wavelength of D – band (from 1325 to 1387 cm-1) were also observed at different power density of laser excitation.

CONCLUSIONS

Laser irradiation of PVD samples leads to change the structures from fullerene-like to graphite-like.
The relationship between power density and amorphisation degree (shapes of raman spectra) was noticed.

ACKNOWLEGMENT

This project is co-founded by the European Regional Development Fund within the Innovative Economy Operational Programme 2007-2013 (title of the project "Development of technology for a new generation of the hydrogen and hydrogen compounds sensor for applications in above normative conditions" No UDA-POIG.01.03.01-14-071/08-04)

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