NANODIAMOND ON POROUS SILICON

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1. Introduction

Porous silicon (PS) has been used for diamond growth, because when appropriately prepared this material has interesting features as larger surface area and number of nucleation sites [1]. Besides, studies of new materials for electrochemical applications have shown that nanocrystalline diamond films (NCD) [2] obtained by chemical-vapor deposition (CVD) are an excellent alternative, specifically for electrochemical electrodes. In order to improve the quality of NCD/PS films the CVD/CVI techniques can be used associated, where the gases reagents responsible by film formation diffuse into the pores and deposit under the surface like particles. Using just the CVD technique, the result is a film totally closed covering the porous substrate. For this purpose, the reactor CVD was modified to CVI presenting basically the same configuration but with two gases entrances: one directly over the substrate, like in the CVD reactor, where the gases are activated passing by the hot filaments and starting the nucleation process and growth films; the second gas entrance, the additional CH_4 flux is located underneath and very near the substrates. In this way, two basic configurations for positioning the additional CH_4 flux were used for obtaining the composite material NCD/PS: “above” and “underneath”.

2. Experimental

The PS samples were prepared by seeding process with 0.25 μm diamond powder immersed in ultrasonic hexane bath during 60 min, followed by their cleaning in acetone for 5 min. Finally, NCD films were grown from CVD/CVI processes with an additional carbon source using the configurations “above” and “underneath”. The films were deposited in a hot filament reactor, at 970 K substrate temperature, 4 kPa total gas pressure, 200 sccm gas flow rate in a gas mixture of Ar 90 vol.% , H_2 9 vol.% and CH_4 1 vol.%, principal flow. The additional CH_4 flow was located “underneath” and also “above” the PS substrate and for these two positions the concentration of the CH_4 varied between 0.5 and 1.0 vol%., to analyze the influence of CH_4 additional source on growth mechanism.

3. Results and Discussions

Figure 1 shows images MEV, high resolution X-ray and Raman scattering spectroscopy measurements for samples obtained using gases mixtures with the following concentrations: 1.0% - 1.0 % CH_4 (a) under configuration “underneath” and (b) “above”. Comparing NCD films obtained using both configurations, “above” and “underneath the results show that the utilization of additional CH_4 flux positioned over the sample result in films of better quality, as can be observed by Raman spectroscopy and high resolution X-ray diffraction.

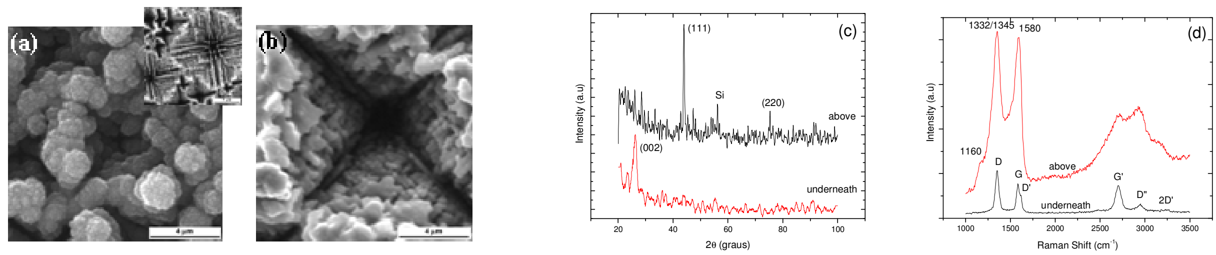

Fig. 1. *Measurements for NCD films obtained with additional CH_4 flux under configuration “underneath” and “over”, with 1.0-1.0% CH_4. Images MEV:* **(a)** *configuration “underneath”, inset - image of PS used as porous matrix for growth and infiltration NCD films,* **(b)** *configuration “above”,* **(c)** *high resolution X-ray measurements,* **(d)** *Raman scattering spectroscopy.*

4. References

[1]- N.G. Ferreira, et al., Diamond Relat. Mater. **14**, 441-445, (2005).

[2]- D. M. Gruen, Nanocrystalline diamond films, Annu. Rev. Mater. Sci. **29**, 211-259, (1999).

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