

Boron doped-diamond growth on carbonaceous materials

A. V. Diniz^{1,2}, E. C. Almeida², V.J. Trava-Airoldi², N.G. Ferreira²

¹Departamento de Química- ITA-CTA,
Pça. Mal. Eduardo Gomes, 50, 12.228-901, S.J. Campos, São Paulo, Brazil

²Dimare- LAS- CTE- INPE,
Av. dos Astronautas, 12245-970, S.J. Campos, São Paulo, Brazil

The singular properties of semiconductor diamond have motivated many studies about their electrochemical applications and new materials as substrate. Particularly, carbonaceous materials, by presenting a high thermal and electrical conductivity, are very attractive for diamond deposition [1]. In this work, boron doped diamond (BDD) films were grown on reticulated vitreous carbon (RVC), carbon cloth and carbon felt by hot filament chemical vapor deposition (HFCVD) for future applications as porous electrodes. The films were deposited 5-20 hours, after seeding pre-treatment, at 1100 K from a 0.5-1% H₂/CH₄ mixture at a total pressure of 20-50 torr. Morphological and structural characterizations were made by Scanning Electronic Microscopy (SEM) e Micro-Raman Spectroscopy. Boron was obtained from H₂ forced to pass through a bubbler containing B₂O₃ dissolved in methanol. The doping level range may be controlled by the B/C ratio in the precursor mixture. The produced films have acceptor concentration values from 6.5×10^{18} to $1.5 \times 10^{21} \text{ cm}^{-3}$, obtained from Mott-Schottky plots measurements discussed in previous work [2].

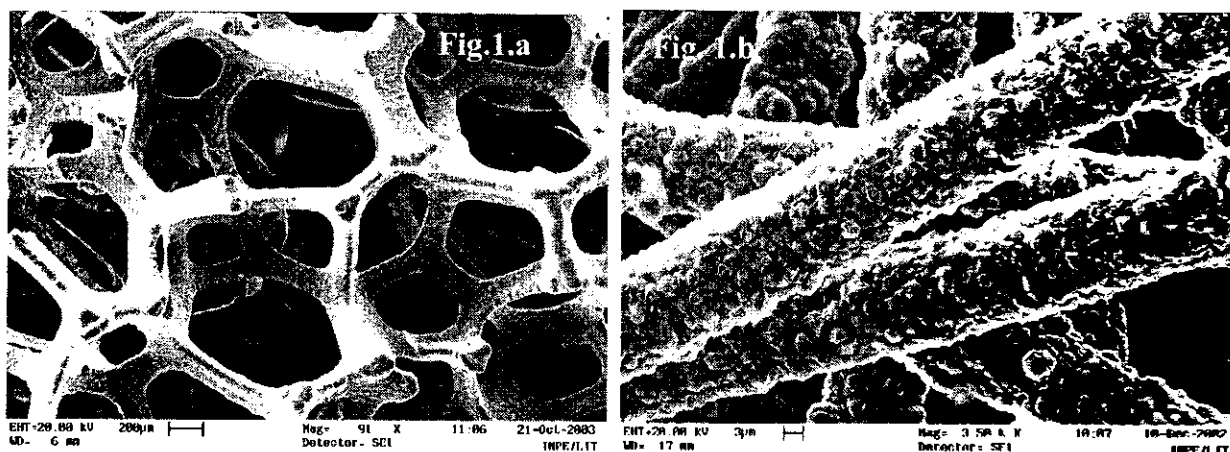


Fig.1 shows SEM images of diamond on RVC (a) and carbon felt (b) at different magnitudes. The polycrystalline and uniform films covering all substrate, including deeper planes, with good adhesion. The texture present preferentially (111) and (100) type planes. In addition, the grain size varies between 1.5 and 3.0 μm with symmetrical and smooth faces.

Raman spectroscopy analyses have confirmed the similarity between the doped diamond films spectra grown on the three different substrates. The characteristic diamond line at 1332 cm^{-1} decreases and shifts to lower energy if the doping level of the film is increased. Besides, the broad peak at 1220 cm^{-1} becomes more evident. The nanodiamond characteristic peak at 1150 cm^{-1} is also evident in the Raman spectra due to the higher nucleation rate observed in such substrates. It is explained due to the hydrogen radicals etching that increases the carbon concentration in gas phase.

[1] J.Ting, M.L.Lake, J. Mater. Res. 9, 636 (1994).

[2] N. G. Ferreira, L. L. G. Silva, E. J. Corat, V. J. Trava-Airoldi –Diam. Rel. Mat., 11 (2002) 1523.