The role of the argon concentration on the evolution of morphology and structural properties of boron doped diamond

Bárbara da Silva Pinheiro[1], Luiz Carlos Rosa[2], Denis Angelo da Silva[3], Jossano Saldanha Marcuzzo[1,4], Emerson Sarmento Gonçalves[5], Mauricio Ribeiro Baldan[2]

[1]Instituto Nacional de pesquisas espaciais, [2]Instituto Nacional de Pesquisas Espaciais, [3]Universidade Federal de São Paulo, [4]Faculdade de Tecnologia de São Jose dos Campos, [5]Instituto de Aeronáutica e Espaço

e-mail: barbarapinheirosjc@outlook.com

Boron-doped diamond films have been grown by hot filament chemical vapor deposition reactor in $Ar/H_2/CH_4$ gas mixtures. Diamond films were grown using different argon concentrations X=0,10,30,40,60, with (99-X)% H_2 and 1%CH_4. An additional H_2 line passing through a bubbler containing B_2O_3 dissolved in metanol was used to carry the boron during the doping process. The substrate temperature was kept at 630 ◦C. The electrically heated tungsten filament positioned under the substrate surface was used to activate the gas mixture. The pressure and flow of the gas mixture $Ar/H_2/CH_4$ were kept constant during all the deposition experiments. The deposition time was about 16 h. Three film sample sets were produced a) without dopping; b) without doping with the additional H_2 line passing through metanol solution and c) with doping. This investigation describes separately the influence of argon, metanol solution and boron solution on the morphology and structural properties of the diamond films. Raman Scattering Spectroscopy confirmed growth of diamond with the characteristic peak located at 1332 cm^{-1} and the doping of film with the appearance of bands at 1220 and 500 cm^{-1}, as well as the presence of graphite due to G-band located at 1580 cm-1. The micrographs of scanning electron microscopy reveal that the surface morphology, the grain size, and the growth mechanism of the diamond films depend strongly on the ratio of Ar to H_2 in the reactant gases. The addition of argon to the growth gas mixture clearly revealed the transition from microcrystalline to nanocrystalline diamond films. The additional H_2 line through the metanol solution (without B_2O_3) did not provides a substantial changes in the morphology and structural properties. As far as boron doped diamond films concern, from the separation of the three contributions it was possible to attribute the existence of additional bands in the Raman spectra only due to the presence of B_2O_3.