NANOCRYSTALINE DIAMOND COATING ON CARBON FIBERS TREATED AT DIFFERENT TEMPERATURES

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1. Introduction

Carbon based materials in their different allotropies have been widely studied due to their singular properties for important technologies, such as aerospace, biomedical, and electrochemical applications. Diamond nanocrystal is a topic of considerable interest in the scientific community, as properties of these systems are expected to retain a large extent of singular characteristics concerning to polycrystalline diamond films[1]. Nanodiamond/Carbon Fiber (ND/CF) should be considered as a three dimensional composite. This study presents the homogeneous nanocrystalline coating on carbon fibers (CF) produced at different graphitization index of 1000, 1500 and 2000 °C. The hydrogen, nitrogen and oxygen concentration are analyzed in the light of the X-ray photoelectron (XPS). The morphologies of the ND films are mainly focused on the detailed description of the nature and the relative abundance of the dominant chemical species present on the CF substrate.

2. Experimental

CF samples were produced from a polyacrylonitrile precursor at HTT by using temperature steps of 30°C/h within inert atmosphere with a nitrogen flow of 1 $L.h^{-1}$, reaching maximum temperatures of 1000, 1500 and 2000 ºC. The samples are denoted as CF-1000 CF-1500 and CF-2000. The nanodiamond films were grown by hot filaments chemical vapor deposition technique. The gas mixture of 90% Ar/10% H_2, total flux of 100 sccm, plus a small amount of CH_4 varying from 0.25 – 1% at a total pressure of 6.5 x 10^3 Pa were used. The resulting composite materials were denoted as ND/CF-1000, ND/CF-1500 and ND/CF-2000. The diamond quality was obtained from Raman spectra recorded by a Renishaw microscope system 2000. The quantitative and qualitative chemical surface compositions were investigate by X-ray photoelectron spectra.

3. Results and Discussions

The XPS long scan spectra of CFs, treated at 1000, 1500 and 2000 °C, is presented in Fig 1. The survey spectra for CFs reveal the elements nitrogen, oxygen and carbon. To analyze and discuss diamond morphologies on CF substrate some important contributions should be considered: first, the presence of non-carbon elements on CF substrates and second, the HTT effect on preferential orientation of the graphitic sheets. The third major contribution comes from the gas-surface reactions that involve the H abstraction and its interaction with the substrate and non-carbon elements. The ND films electron micrograph images grown on CF substrates is presented in Fig.2, associated with its Raman spectrum. ND films showed a uniform morphology and texture covering all the fibers as may be observed in figure. The dependence between diamond morphology and CF treated at different temperatures was related to its structural and superficial properties.

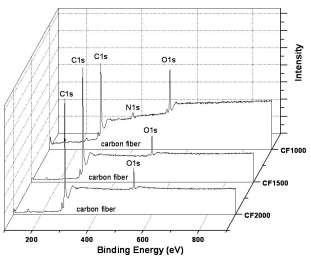

Fig. 1. *Survey spectra of CF-1000, CF-1500 and CF-2000.*

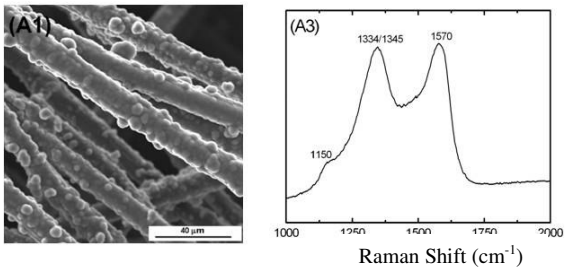

Fig. 2. (A1)-*SEM images of ND/CF-1000.*
(A3)- *Raman spectrum of ND covering the CF-1000*

4. References

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