STUDY THE EFFECT OF HIGH ENERGY MILLING OF DIAMOND CVD

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1. Introduction

Diamond nanoparticles, (NDs), have been studied as nanostructures suitable for spatial and biomedical applications. NDs are inert, optically transparent, photoluminescent, biocompatible and can also be functionalized in many ways depending on their final application. [1, 2]. This work aims to investigate the effect of high energy grinding on the morphology, particle size and compressibility of DIAMANTE CVD. CVD diamond is synthetic but has the same physical and chemical properties as natural diamond: extreme hardness, excellent thermal conductivity, very low coefficient of friction, is biologically compatible, chemically inert to temperatures below 800ºC, among others. This evaluation allowed to observe the morphological behavior and the interaction between the components of the material produced. The results show that milling time (MAE) and centrifugation leads to the reduction of particle size followed by formation of agglomerates, WC contaminants have been found in NDs, this contamination occurs due to wear of the beads during high energy collisions.

2. Experimental

The process of synthesis of this material in the Company was initially developed by INPE DIMARE Group and the technology transferred to the company through a partnership. The CVD diamond production technique is the hot-filament chemical vapor deposition (HFCVD). The diamond-CVD grinding was performed for times of 1, 2 and 3 hours. In order to observe the influence of grinding time on the microstructure and size of the nanoparticle, the techniques of Scanning Electron Microscopy with Field Emission (MEV-FEG), EDS, Light Scattering were used.

3. Results and Discussions

The effect of centrifugation time on particle size was characteristic to the proportions in which they were determined and represented respectively by D10, D50 and D90. The results are shown in (Fig. 1). It can be seen that as the spin time increases the particle size becomes smaller. The technique chosen to obtain the nanodiamond allows to evaluate the morphology of the particles before and after the MAE time. One can observe the faceted morphology of its crystals and some homogeneity in particle size (Fig. 2 (a)). Micrography of the nanodiamond powder after milling can observe the typical shape and state of agglomeration of the material. It was observed that there was a morphological difference of the NDs due to WC contaminants (Fig. 2 (b)). Through the EDS, it was possible to visualize the carbon peak in the diamond samples and after the MAE there were carbon peaks and WC , This is explained by the contamination of the sample by the WC particles from the grinding bodies. This contamination occurs due to ball wear during high energy collisions. With the wear the material that composes the grinding bodies passes to the powders [3]. Whenever possible it is desirable that the material of the grinding bodies be the same as the powders to prevent contamination. Decontamination of NDs will be done with hydrochloric acid (HCl).

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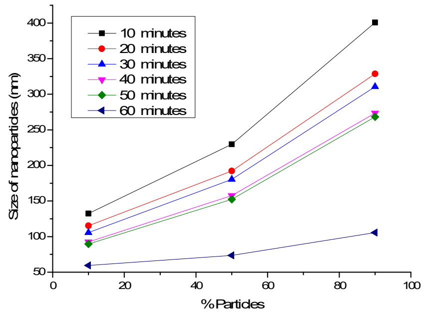

Figure 1: Effect of centrifugation time on particle size (D90).

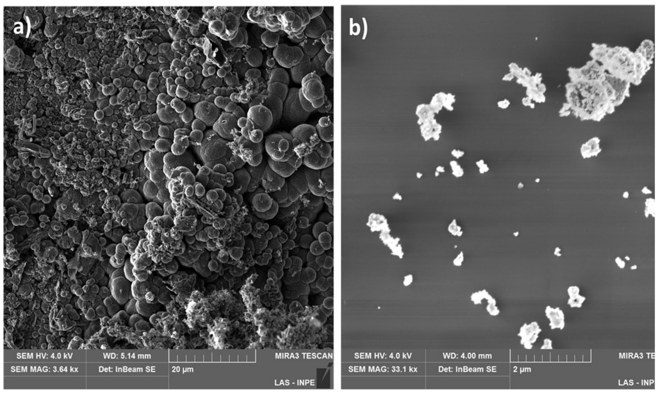

Figure 2: Field Emission Scanning Electron Microscopy (SEM-FEG) (a) Diamond (b) after 3 hours of MAE.

5. References

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