Biased enhanced nucleation of nano-crystalline diamond as precursor for high-adherent diamond/Ti6Al4V films

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We have combined bias voltage (–150 to –600V) and methane concentration (1% to 8%) with a surface-wave guide discharge reactor to investigated diamond nucleation on Ti6Al4V alloy. Nano-crystalline diamonds with high-density nucleation were successfully obtained by using a negative bias voltage of – 400 V applied between the plasma shell and substrate into atmosphere with 8% of methane in hydrogen. Nucleation density was evaluated by top view Scanning Electron Microscopy (SEM) micrographs and it achieved 5.0 x 10^9 part/cm^2 in just 5 minutes of bias time as shown in Fig.1.

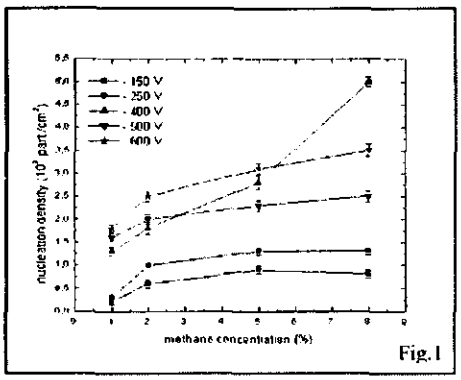

Fig.1

Diamond films deposition was performed using an enhanced 2.45 GHz microwave assisted technique, based on surface-wave guide discharge (Surfatron system). The films growth rate was around 0.7 μm/h and showed a good quality and a total residual stress of – 1.4 GPa that were evaluated by Raman scattering spectroscopy.

Also, it was investigated the diamond films adherence on Ti6Al4V alloy as a function of film growth time. A Rockwell indenter with loads higher than 1471 N (that corresponds to the usual value of 150 kgf) was used for this test and the films presented good adhesion independent of growth time. This adherence was analyzed from the films micrograph after the indentation test by SEM as shown in Fig.2. This film was grown on Ti6Al4V alloy during 150 minutes and a load of 2451 N (250 kgf).

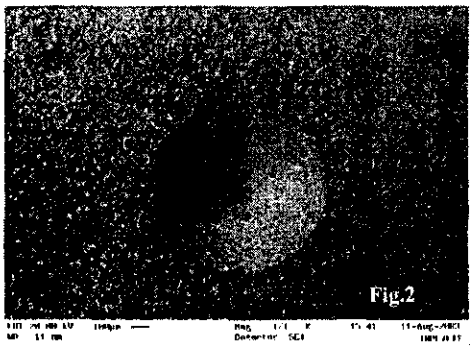
Fig.2