HARDNESS AND ADHESION OF CVD DIAMOND MULTILAYER COATINGS

J. Vieira[1*], A. Contin[1], M. A. Fraga[1], R. C. Alves[2], E. J. Corat[1] and V.J. Trava Airoldi[1]
[1]*Instituto Nacional de Pesquisas Espaciais, São José dos Campos, Brasil*
[2]*Universidade Federal do Sul e Sudeste do Pará, Campus Marabá, Brasil*

1. Introduction

Because of its hardness, abrasion resistance and thermal conductivity, CVD diamond has been shown as a suitable coating material to meet requirements of performance and lifetime of the machining tools [1-2]. This work investigates the hardness and adhesion of diamond multilayer coatings grown by hot-filament chemical vapor deposition (HFCVD) on WC-9%Co substrates.

2. Experimental

As a first step a polishing procedure was performed until a mirror looking surface. Then the substrate was subjected to a chemical etching, initially an ultrasonic bath in Murakami's solution which erodes the substrate's surface by attacking the tungsten carbide phase hence exposing the Cobalt binder phase, target of the second stage of this treatment, an immersion under Aqua Regia solution causing its removal, the sample was washed with pure water after each stage. After this, substrates were seeded with 4 nm diamond particles and led to the deposition process. The deposition was conducted in a HFCVD reactor, and a coating with five alternate layers of UNCD and MCD were grown in the sequence shown in Fig.1. In order to evaluate the structure, morphology, adhesion and hardness, Raman spectroscopy, FEG-SEM and AFM were performed as well as 600 N Rockwell C indentation and nanoindentation tests.

3. Results and Discussions

As can be observed from load-displacement curves shown in Fig. 2, the diamond multilayer coating is more resistant to deformation than the WC-9%Co substrate. Hardness of the multilayered coating was found to be 48.5 GPa, whereas that of the substrate was of 22 GPa. Fig. 3 and 4 shows the FEG-SEM images of the multilayered coating after Rockwell indentation at 60 kg load.

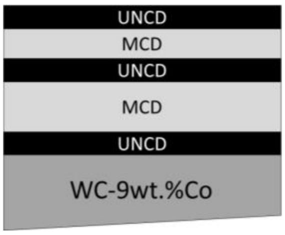

Fig. 1. *Schematic design of the multilayer of UNCD and MCD CVD diamond coating.*

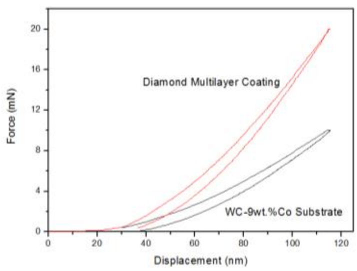

Fig. 2. *Load-displacement curves obtained during nanoindentation of the substrate (WC-9wt.%Co) and of the sample with multilayer CVD diamond coating.*

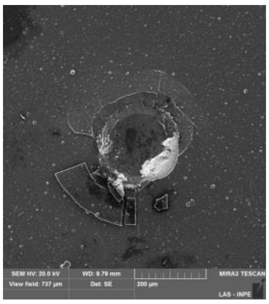

Fig. 3. *FEG-SEM of 600 N Rockwell C indentation of the sample at 320x magnification.*

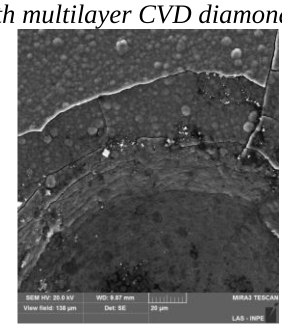

Fig. 4. *FEG-SEM of 600 N Rockwell C indentation of the sample at 2 kx magnification.*

4. References

[1] E. Salgueiredo et al, Wear, **297**, 1064-1073, (2013).
[2] M A Fraga et al, Mater. Res. Express, **3,** 025601, (2016).

Acknowledgments

To FAPESP (processes number: 12/15857-1, 14/18139-8 and 13/25939-8) and CAPES for financial support.

*Corresponding author: jvneto.ifsp@gmail.com