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A NOVEL APPROACH TO REMOVE DLC COATING FROM CEMENTED CARBIDES TOOLS BY USING LOW-ENERGY HIGH-CURRENT ELECTRON BEAMS *

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Deposition of carbon-based coatings, such as Diamond-Like Carbon, is a highly effective procedure to further increase the useful lifespan and the performance of hard metals tools. However, considering the harsh service conditions in which industrial utensils are employed, DLC coatings are subjected to wear and this affect in turn their efficiency and cutting ability [1,2].

For this reason, tool reconditioning aimed at the reuse of the Co-cemented carbide substrates would guarantee a remarkable cost reduction for industries and a lower consumption of raw materials. Consequently, a successful technique for DLC decoating is required, which would allow the WC-Co surface to be re-sharpened and coated again. Of course, the stripping process is deemed efficient only when the coating is fully removed without inflicting irreversible damages to the substrate. Even though DLC films have grown in popularity during the last decades, very little attention has been devoted to the issue of diamond-like carbon decoating. [3,4]

In the present work, a Low-Energy High-Current Electron Beam has been used to remove two different type of DLC coatings: a-C:H and Ta-C (both 1.5 µm thick). In between the DLC and the Cr adhesion layer (100 nm), a-C:H samples also presented a W-C:H transition layer (1.2 µm). Moreover, a preliminary analysis on bare WC-Co (Co wt.%: 2.0 ± 0.4) has been done to investigate the effects of LEHCEB on Co-cemented carbides. The entire experimental procedure was assisted by a detailed computational simulation to predict and better understand overall results.

The decoating process was done using a relatively low number of pulses, up to 20, with accelerating voltage of 20, 25 and 30 kV (associated energy density up to 5-6 J/cm^2). The aim was to find the minimum energy threshold for a complete and uniform cleaning of WC-Co surface. On the other hand, uncoated samples were treated with a higher number of pulses, up to 40, at 15, 20 and 25 kV in order to assess the beneficial or detrimental effects of a prolonged LEHCEB irradiation. At the end, a combination of the two aforementioned treatments has been used to study the influence of electron beam treatment on the adhesion of a new DLC coating on cleaned WC-Co substrates. Then, concerning computational models, calculations on Co binder and Cr adhesion layer were focused on solid-liquid transitions and melt state properties. Simulation of WC was concentrated on depth thermal profiles and thermal stresses while DLC a-C:H and Ta-C were simulated mainly to evaluate the evaporation threshold and ablation rate.

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