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Decoating of cutting tools exploiting vacuum and liquid plasma technologies

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Diamond-Like Carbon (DLC) and Titanium Nitride (TiN) coatings are widely employed to increase the useful lifespan and performances of Hard Metal (HM) and High-Speed Steel (HSS) cutting tools, especially for harsh and severe service conditions. Then, at the end of the service life, tools will present damages and defects that lead to their decommissioning. For this reason, an effective procedure to remove DLC and TiN from the HM and HSS surfaces is required to allow for the substrates to be resharpened, recoated and reused. In the present research, vacuum and liquid plasma technologies are implemented to tackle the issue of cutting tools decoating, with an eye on avoiding the use of harmful chemicals in the process. Low-Energy High-Current Electron Beam (LEHCEB) [1] was employed to strip DLC coatings from WC-Co4 inserts while Plasma Electrolytic Polishing (PEP) [2] was used to remove TiN coatings from AISI M2 drill bits. LEHCEB is a vacuum plasma technique that is able to rapidly bring the DLC coating to sublimation, allowing for its complete removal within few tens of seconds. Different combinations of electron accelerating voltages (20-30 kV) and number of pulses were studied to assess the optimal decoating parameters. On the other hand, PEP is a liquid plasma technique in which the application of a high voltage (100-400 V) lead to the formation of vapour gas envelopes on the conductive surface of TiN, allowing to strip the coating in few minutes of DC polarization. Different combinations of diluted (1-6 wt.%) and eco-friendly electrolytes were investigated to determine the optimal time and temperature of decoating.

[1] doi.org/10.1016/S0257-8972(99)00604-0
[2] doi.org/10.1007/s00170-021-07012-7

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