Contribution ID: **45** Type: **Oral Presentation - an extended abstract will be submitted**

Tribological and microstructural characterization of Coatings used on C75 tool steel

Tuesday, 25 March 2025 16:30 (20 minutes)

C75 tool steel is a very widely used material in several technological fields due to its low cost and high availability combined with good mechanical properties. However, the material is prone to environmental degradation, sometimes combined with tribological degradation, in which case a coating is necessary to avoid these problems, with the main aim of increasing the environmental and mechanical degradation. In particular for this purpose, Ni-based coatings, Cr-based coatings.
The samples were subjected to microstructural characterization using SEM in cross-section to evaluate both the thickness and the microstructure of the coatings. Vickers microhardness tests were then carried out at different loads, from HV2 to HV0.01 in plan view. To evaluate both the adhesion and abrasion resistance of the coatings, scratch tests were carried out with a constant initial load of 1N, increasing by 1N per test until scratches were visible to the naked eye. The tribological characterization was carried out using a tribometer in a pin-on-disc configuration. The tests lasted 1 hour, at a speed of 300 rpm, with an applied load of 50 N. The counter material was a C40 pin with a diameter of 6 mm. The wear traces were then analysed using SEM to assess the wear mechanism and a stylus profilometer to assess the depth of the wear trace, which was necessary to calculate the wear rate.
The analyses showed that not all electroplated coatings are effective against the main degradations analysed in this work. Specifically, samples with thicker coatings performed worse than those with thinner coatings. In fact, some coatings improved wear relative to bare steel, while others proved to improve the wear resistance of the coated system. It should be noted that in some cases the surface hardness was improved abruptly (above 1000HV).

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Session Classification: Surface Treatment & Coating

Track Classification: Processing: Surface treatment of tool material