Laser Impact on Contact Responses of Coated Cemented Carbides

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Nanosecond laser is considered a fast and clean surface treatment for hard materials, as it can usually achieve a good surface finish with minimal thermal influence on the working surface, compared to electrical machining. Coating, as a posterior treatment for cemented carbide to improve mechanical properties, is sensitive to the geometric and microstructural conditions of interfaces. Within the laser-coating system, it is of interest to investigate the impact of laser on the surface conditions, which might change the mechanical properties of coatings.

Keywords: Cemented Carbides, nanosecond laser, coating, scratch, adhesion.

1. Introduction

A selected cemented carbide grade will be treated by a nanosecond laser and deposited by a hard PVD-coating. A micro-scratch testing set-up will be implemented to interpret the laser impact by the acoustic emission, penetration, and friction during the sliding. Adhesive properties of the coating on laser machined cemented carbide will be studied. Topographic characteristics associated with surface damage after the tests will be revealed using the scanning electron microscope (SEM).

2. Methods

2.1. Material studied

A plain WC-Co cemented tungsten carbide (10CoC) will be studied (Table 1).

Table 1. Microstructural characteristics and properties of the studied cemented carbide.

Cemented Carbide Grade	Grain Size (µm)	Co (wt%)	HV (GPa)	K_{Ic} (MPam$^{1/2}$)
10CoC	0.31	10	11.4	15.8

2.2. Laser ablation and coating deposition

A Nd:YLF nanosecond laser (Spectra Physics) is used to carry out the ablation of 10 µm on the target 10CoC samples with a pulse energy of 10.3 µJ [1]. Followed by laser, an AlTiN hard coating layer (Hyperlox, Flubetech S.L.,) with a thickness of 2 µm is deposited on the lasered surfaces using an industrial PVD installation (CC800®/9 HiPIMS, CemeCon AG). Two conditions are achieved: (1) polished surface being coated (P+C), (2) polished surface being lasered and coated (P+L+C).

2.3. Sliding contact responses in the scratch test

The sliding contact responses were obtained using a scratch tester (Revetest, CSM Instruments). The tests were conducted by a Rockwell diamond indenter with a radius of 200 µm, moving in one direction and pressing against the target surface by a normal load progressively increasing with a constant loading rate: 10N/min from 0N to 100N. The sliding contact response is quantified by the curves of penetration-sliding distance.

3. Preliminary results

More penetration is observed on the non-lasered sample than the lasered one, indicating that penetration resistance to the normal load is reinforced by the laser treatment (Fig.1). The lasered one also demonstrates a cleaner surface at the end zone of the sliding track (Fig.2).

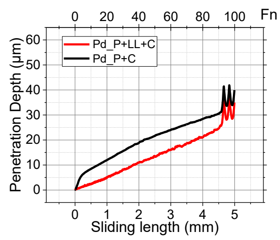

Figure 1. Penetration depth as a function of the sliding length (load) in the unidirectional scratch test.

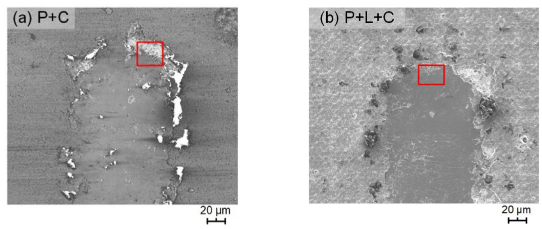

Figure 2. SEM micrographs of the scratches.

4. References

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