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ABSTRACTS

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A COMPARATIVE STUDY ON THE EFFECT OF SURFACE PREPARATION ON THE FRICTION BEHAVIOUR OF THE DLC COATING ON A COLD WORK TOOL STEEL SUBSTRATE

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Superhard ceramic coatings like DLC is widely used in various applications e. g. for improving wear resistance of structural elements and tools. Tribological performance of the superhard top layers is influenced by various factors, among the others the substrate properties.

The objective of the current research is to investigate the effect of the surface preparation method on the tribological performance of DLC coatings on a cold work tool steel – Böhler K110 (1.2379; X153CrMoV12) used e.g. in automotive industry. Wear behaviour was investigated using ball-on-disc wear test (machine: UNMT-1 producer CETR) with $F = 5, 10$ and 30 N normal loads, and $v = 10$ and 30 mm/s sliding rates, using SiC ball counterpart ($\phi 6\text{mm}$) in unlubricated conditions at room temperature.

The substrate material was differently prepared before the coating procedure, i.e. it was glass bead blasted (GBB) and polished (P). After these surface preparations the steel substrates were DLC coated using PACVD (Plasma-Assisted Chemical Vapour Deposition). The coating system consisted of Cr/CrN/WC underlayer with DLC top layer and was identical for each specimen. The wear behaviour was characterised by the friction coefficient determined during ball-on-disc tests.

The most important findings derived from this experimental work, are as follows:

Friction coefficient values obtained for specimens having polished substrate were systematically and significantly (30-50%) lower compared with those obtained for specimens having GBB surface preparation.

The effect of the loading parameters of the friction coefficient could also be evaluated from these tests. The friction coefficient was higher with the increase of the normal load and of the sliding rate. The rate-sensitivity was less expressed at the higher normal loads.

It is supposed that the observed difference in the friction behaviour of the differently prepared samples can be attributed to the supposedly different residual stress states developing in the surface layer as a result of the different surface preparation, and these residual stresses can favourably modify the friction behaviour of the coatings, as well. In general polishing operations can result in a measurable compressional residual stress state in the surface layer of the metallic materials.

The practical importance of these findings is to emphasise the importance of each steps of the coating technology, due to their possible influence on the tribological behaviour of the whole material system represented by the substrate and coating together.

The direction of the further research work is to characterize quantitatively the residual stress state of the substrate material with the investigated surface preparation procedures.

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