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Investigation of surface pretreatment on cemented carbide cutting tools by plasma electrolytic polishing (PEP) for enhanced hard coating adhesion

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Machining tools such as milling, turning, or drilling tools play a key role in a wide range of industrial production sectors. In order to maximize a tool's service life time, high-quality hard coatings on the tool surfaces are required. Prior to coating, the surface contamination created during the tool manufacturing process has to be thoroughly cleaned with a defined pretreatment method to ensure sufficient adhesion between hard coating layer and tool surface. The plasma electrolytic polishing (PEP) technology has received much attention owing to not only the significant improvement of surface properties in a short period of time, but also its ecological benefits. However, so far PEP treatment for carbide materials, a typical material for machining tools, is still a premature method as far as practical application is concerned. In this study, we report on the process optimization of PEP as a suitable pretreatment step on the surface of cemented carbide cutting tools. The PEP process was firstly conducted to clean the grease contamination smeared during cemented carbide tool manufacturing while minimizing tool surface compositional change and cutting edge deformation. The cemented carbide workpiece was immersed in a cathodic bath filled with an aqueous electrolyte solution and was anodically polarized (U = 90 ~ 300 V). Electrical conductivity and pH value of the electrolytic solution were controlled up to 200 S m^{-1} and 11, respectively, by adding different types of salt. Furthermore, the workpieces were treated by varying the process parameters such as time, temperature, and workpiece position. Afterwards, a hard coating layer was deposited on the PEP treated surface by physical vapor deposition (PVD) and turning tests were performed to evaluate the coated tool's service life time.

Keywords
plasma electrolytic polishing
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