

Innovative pre-treatment optimizes service life of CVD-diamond-coated carbide tools

Field of application

Diamond coated cemented carbide cutting tools are increasingly being used to reduce process costs in industrial component production and to increase quality. The problem so far has been the insufficient layer adhesion, especially in the processing of increasingly important composite and lightweight materials (e.g. CFRP or metal matrix composites). A suitable pre-treatment is therefore essential. Against this backdrop, an innovative process has now been developed to replace the previously common pre-treatment routine, which quickly reaches its limits, especially in applications with heavy tool stress, and has a correspondingly restrictive effect on the service life of diamond-coated cemented carbide tools.

State of the art

Cemented carbide is a composite material made of very hard tungsten carbide in combination with a metallic matrix (e.g. from cobalt). However, when coating with diamond, the latter impairs the adhesion of the coating to the tool. Up to now, wet-chemical pre-treatment has been used to remove the cobalt in an area close to the surface. Consequently, this approach has a negative effect on the fracture toughness and, especially under dynamic loads, leads to disruption of the tool surface and premature failure. Despite extensive efforts to overcome the problems of layer adhesion and interface stability, past approaches and procedure adjustments still have not been able to satisfactorily fulfil service life requirements.

Innovation

An innovative process has now been developed at the Fraunhofer Institute for Mechanics of Materials IWM in a project funded by the Baden-Württemberg Stiftung gGmbH. By applying a thermochemical process in combination with a plasma, a sequential stabilization and structuring of the tool surface is achieved by recrystallization of the substrate edge zone, the post-diffusion of cobalt through an intergranular implemented CoWO₄ diffusion barrier is prevented and the specific adhesion of a subsequent diamond coating is mediated via a silicon oxycarbonitride coating (a-SiOCN).

Technology transfer

Technologie-Lizenz-Büro GmbH is responsible for the exploitation of this technology and assists companies in obtaining licenses.

Your benefits at a glance

- ✓ Longer service life
- ✓ Increased fracture toughness at the cutting edge and interface
- ✓ Different types of hard metal can be used
- ✓ Very short process cycles
- ✓ All procedure steps possible in a single interrelated process
- ✓ Particularly suitable for tools for processing materials that are difficult to machine
- ✓ Additional applications are forming tools or drawing dies for the wire industry
- ✓ Demonstrators are available

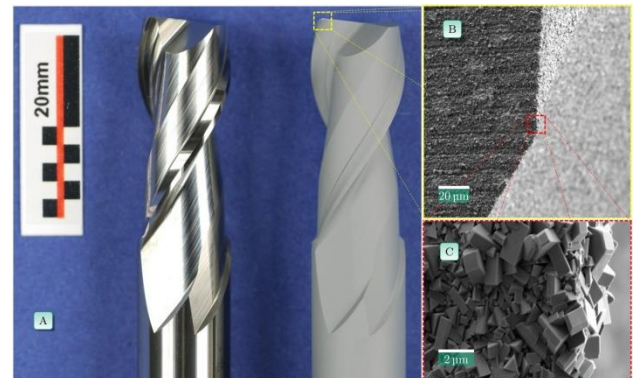


Figure: A) Untreated milling cutter (left), treated milling cutter (right); (B/C) Enlarged sections of the tool surface after pre-treatment; © Foto: Fraunhofer IWM.

Patent portfolio

DE and PCT patent applications are pending.

Contact

Dr. Frank Schlotter

schlotter@tlb.de

Technologie-Lizenz-Büro (TLB)
der Baden-Württembergischen Hochschulen GmbH
Ettlinger Straße 25, D-76137 Karlsruhe
Tel. 0721 79004-0, Fax 0721 79004-79
www.tlb.de

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