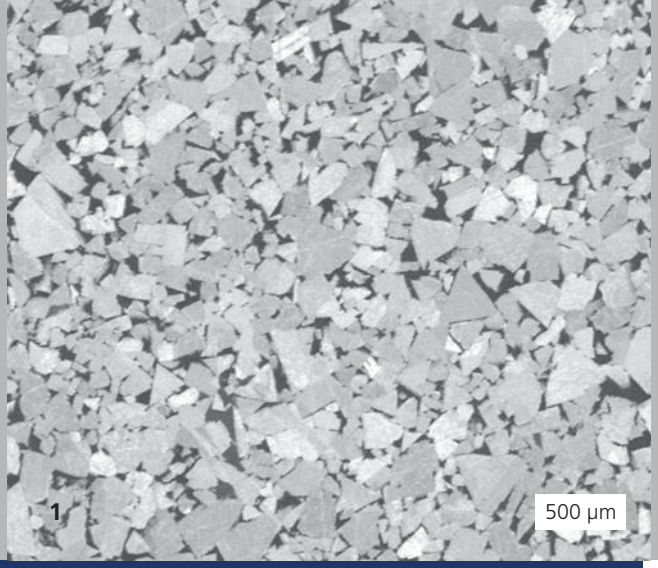

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NANOSCALED TOOL MATERIALS FOR NEW MANUFACTURING TECHNOLOGIES

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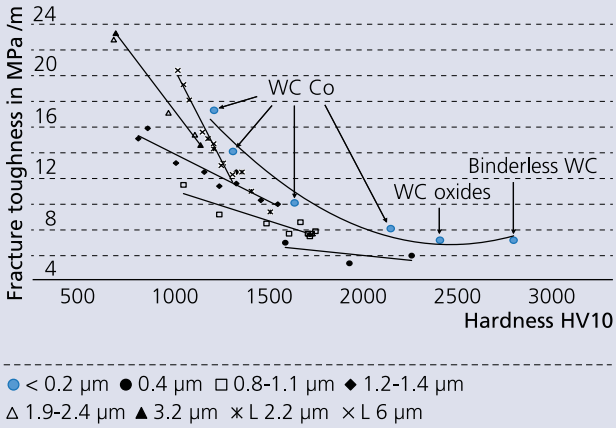
For challenging manufacturing tasks, like the machining of titanium- or nickel-based superalloys, the machining of hardened steels, the turning and milling of hard metals or ceramics as well as the pressing of high-precision glass lenses, a new and particularly efficient tool material is needed. During the last years, the group "Hard Metals and Cermets" has developed several nanoscaled tungsten carbide-based (WC) hard metals. By optimizing the composition and the powder metallurgical production method, tool materials with a significantly increased hardness and fracture toughness could be produced. The production is based on the use of very fine-grained tungsten carbide powders with a mean particle size d_{BET} of around 90 nm. Through the use of adjusted mixing and milling processes, very homogenous mixtures could be made. Green parts were produced by using conventional uniaxial as well as cold isostatic pressing techniques. The sintering of tool parts or blank parts depended on the kind and amount of metal or oxide binder at sintering temperatures from 1300 °C for nanoscaled hard metals over 1550 °C for nanoscaled tungsten carbide oxide composites to 1900 °C for binderless hard metals.

Due to a very fine grain size, these binderless hard metals possess a very high hardness of over 2800 HV10 units. Due to their small grain size as well as their very low surface roughness after polishing, they are the perfect material for the production of pressing dies for high-quality glass lenses. Together with composites made of tungsten carbide and zirconia or alumina, these kind of composites are also used as wear parts or sealing rings.

Nanoscaled tungsten carbide-cobalt hard metals with a metal binder content between 6 and 15 wt.-% show a significantly higher hardness as comparable ultrafine hard metals used today. As shown in diagram 1, both hardness and fracture toughness can be increased by using nanoscaled tungsten carbide starting powders. Furthermore, the bending strength can be increased to more than 4500 N/mm².

Hardness and fracture toughness of nanoscaled WC-based hard metals



Within the BMBF project NanoHM, turning tests on nickel-based superalloys done by Kennametal Widia Essen showed that nanoscaled hard metals have superior properties compared to conventional hard metals tested under the same conditions.

Services offered

- Optimization and production of binderless tungsten carbide ceramics for special applications and production environments
- Development of cemented carbides or tungsten carbide-free cermets
- Characterization of hard metals or cermets
- Failure analysis

1 *Structure of a nanoscaled hard metal WC-10Co, chord length < 100 nm.*
2 *Tools made of nanoscaled hard metal (grinding by Fisch-Tools, Austria).*

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