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Nanoindentation Testing on Mo-B-C Micropillars Prepared by Focused Ion Beam Milling

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Mo-B-C thin films show a favorable combination of high stiffness, hardness and elastic modulus together with moderate ductility and are a promising candidate for the next-generation protective coatings. In this study we focused on micro-compression tests performed on well-defined micropillars with fixed aspect ratio of 2:1 (height x diameter), which were fabricated by a focused ion beam technique as a part of the scanning electron microscope LYRA 3 (Tescan). For the fabrication process, several Mo-B-C coatings with different microstructures were chosen in order to study the influence of the degree of crystallinity on the prevailing deformation mechanism. The micro-compression testing was performed on Hysitron Ti950 Triboindenter equipped with a flat punch indenter (10 μm in diameter). The nanoindentation test was controlled by load or displacement and from the geometry and load-displacement data the true stress and strain were calculated.
The post-mortem analysis on transmission electron microscopes (TEM) Philips CM12 STEM and JEOL JEM-2100F helped us to better understand the deformation mechanisms that lie behind the extraordinary plasticity and enhanced fracture resistance of these coatings. The lamellas for TEM were cut from the deformed micropillars and analyzed afterwards. The calculated critical stresses for Mo-B-C micropillars were compared with other ceramic materials typical for protective coatings in industrial applications.
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