FATIGUE CRACK GROWTH BEHAVIOR OF COARSE-GRAINED HARDMETALS

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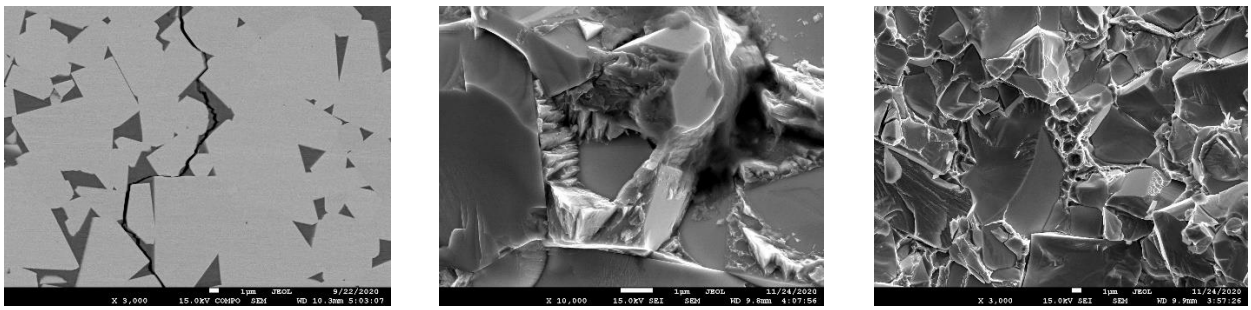
ABSTRACT

Cemented carbides, also referred to as hardmetals, are composites consisting of brittle ceramic particles embedded in a ductile metallic binder. Such a microstructure leads to an excellent conjunction of mechanical and tribological properties. However, the performance of hardmetal components can experience unexpected ruptures under the application of both monotonic and cyclic loads. Attempting to optimize the performance and reliability of coarse-grained cemented carbide grades, a testing procedure focused on the evaluation of fatigue crack growth resistance, was conducted.

Testing procedure include of precracking (i.e. crack nucleation) and subcritical crack growth. Experimental information gathered for both stages is presented. Mechanical testing is complemented with extensive and systematic fractographic inspection by means of Field-Emission Scanning Electron Microscopy. In doing so, special attention is paid to document and understand stable and unstable crack growth mechanisms for the coarse-grained WC-Co hardmetal studied. Evidence of specific fractographic features, such as ductile dimples, crystallographic-like steps or transgranular cleavage, are used for analyzing crack-microstructure interaction under cyclic loading. These results are finally discussed in terms of fatigue crack growth kinetics and prevalence/absence of toughening mechanisms developed under variable loading conditions.



From left to right, 2D crack-microstructure interaction, crystallographic-like steps on stable propagation and ductile dimples observed when unstable failure is triggered.