FRACTURE TOUGHNESS OF THERMAL BARRIER COATINGS DETERMINED BY MICRO-CANTILEVER BENDING TESTS

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To investigate the local fracture toughness of thin coatings new small scale methods like FIB milling of micro cantilever are used. Webler et al. used this technique for measuring the fracture toughness of NiAl bond [1]. This method can also be used to investigate the local fracture toughness of thermal barrier coatings. The fracture toughness of ceramic coatings can be determined by different indentation techniques [2]. The drawback of these methods is the analysis of the K_{Ic}-value without the specific knowledge of the crack front propagation, which can only be determined after the experiment. By using micro-cantilever produced by ion beam milling it is possible to measure the local fracture toughness with freestanding micro-cantilever independent of the substrate. Therefore two yttrium stabilized zirconia (YSZ) top coats with a thickness of 250µm, which were deposited by suspension plasma spraying on a layer of Amdry 9954 bond coat and IN 738 substrate with different standoff distances of about 70 and 100 mm, were investigated. Figure 1. shows the micro-cantilever with the initial crack (a) before testing.

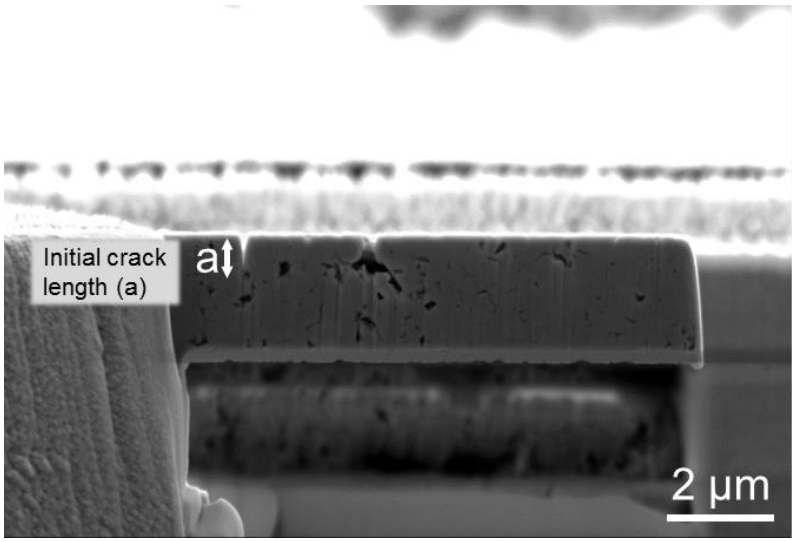

Figure 1: Micro-cantilever in a thermal barrier coating produced by FIB milling with an initial crack length (a).

The bending tests were performed with a micro-manipulator from Kleindiek. The analysis was done with digital image correlation to consider the shifting of the micro-manipulator tip, the bending of the cantilever until fracture and the crack propagation. The purpose was to measure the fracture toughness as a function of the porosity of the thermal barrier coating. Depending on the porosity the fracture toughness scatters between 0.5 - 1.5 $Pam^{1/2}$.

References

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