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Micro-beam bending combined with AFM and FEM for matrix-reinforcement interfacial strength analysis

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Abstract

Tailoring materials properties, especially improving mechanical performance, is one of the driving forces of materials science. Usually such tailoring is provided by manufacturing parameters optimization. However, for understanding the reason for the change in properties, it is crucial to investigate materials microstructure. For composite, properties of matrix and reinforcement play a crucial role for overall properties. Yet another important factor is the matrix-reinforcement interface. Their weak connection leads to premature fracture and poor performance [1].

Standard methods for matrix-reinforcement interfacial strength measurement are uniaxial tensile test and bending test. However, while decreasing the specimen size, geometry of the interface can increase its influence. Moreover, for most of particulate reinforced composites this geometry is not defined as for random shape of particles.

In this work, the influence of interface geometry on mechanical performance in micro-beam bending test is studied. As shown in Fig.1. micro-beams were prepared by FIB-milling and bended with in-situ nanoindenter. Then, geometry of the fracture was acquired used AFM scanning. Next, the experimental geometry of the beam and interface was implemented in FEM model of beam bending.

The results show important role of interface geometry. As an implementation of this approach, Ni-SiC composite coating prepared in [1] was used to fabricate micro-beams and determine interfacial bonding changes depending on fabrication parameters.

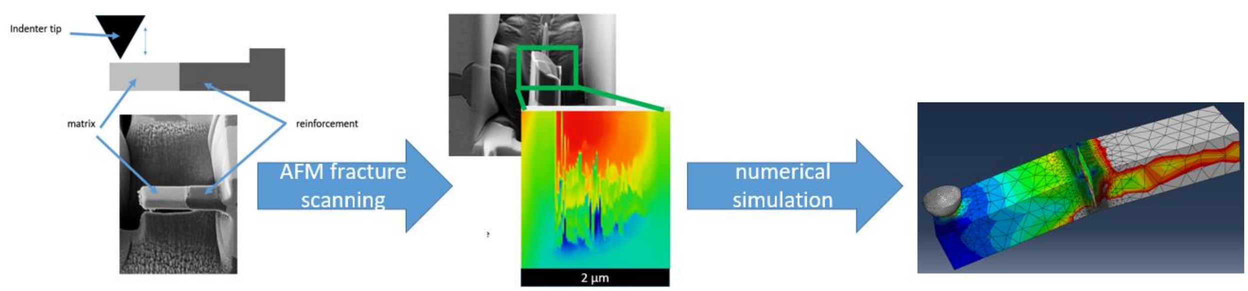

Fig. 1. Procedure for interfacial strength determination

REFERENCES

[1] P. Jenczyk et al. Application of SiC particles coated with a protective Ni layer for production of Ni/SiC co-electrodeposited composite coatings with enhanced tribological properties. Ceram. Int. 45, 23540–23547, 2019