MICROMECHANICAL TESTING OF THERMAL BARRIER COATINGS

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A long-standing challenge in thermal barrier coating (TBC) communities is the lack of capabilities to measure and model the mechanical properties of TBCs because of the limited coating thickness and complex microstructure. Such a knowledge gap has prevented reliable and accurate lifetime predictions for TBCs. As a result, TBCs are used in a highly conservative manner and replaced well before their lifetimes are reached for stringent safety requirements, leaving their full capabilities significantly underexplored. A promising methodology to address this critical challenge is micromechanical testing. The technique involves fabricating microbeams by focused ion beam machining and bending the beams by a nanoindenter to extract mechanical properties (e.g. fracture toughness). Such capability has sufficient spatial resolution to probe site-specific mechanical properties at the length scale of microstructural features and has been proven to be particularly useful to complex coating systems like TBCs. We will present case studies on how micromechanical testing has been implemented to TBCs for determining their mechanical properties. The measurement results will be correlated to microstructural-compositional factors of the coatings to give insight into mechanisms governing the mechanical properties of TBCs.

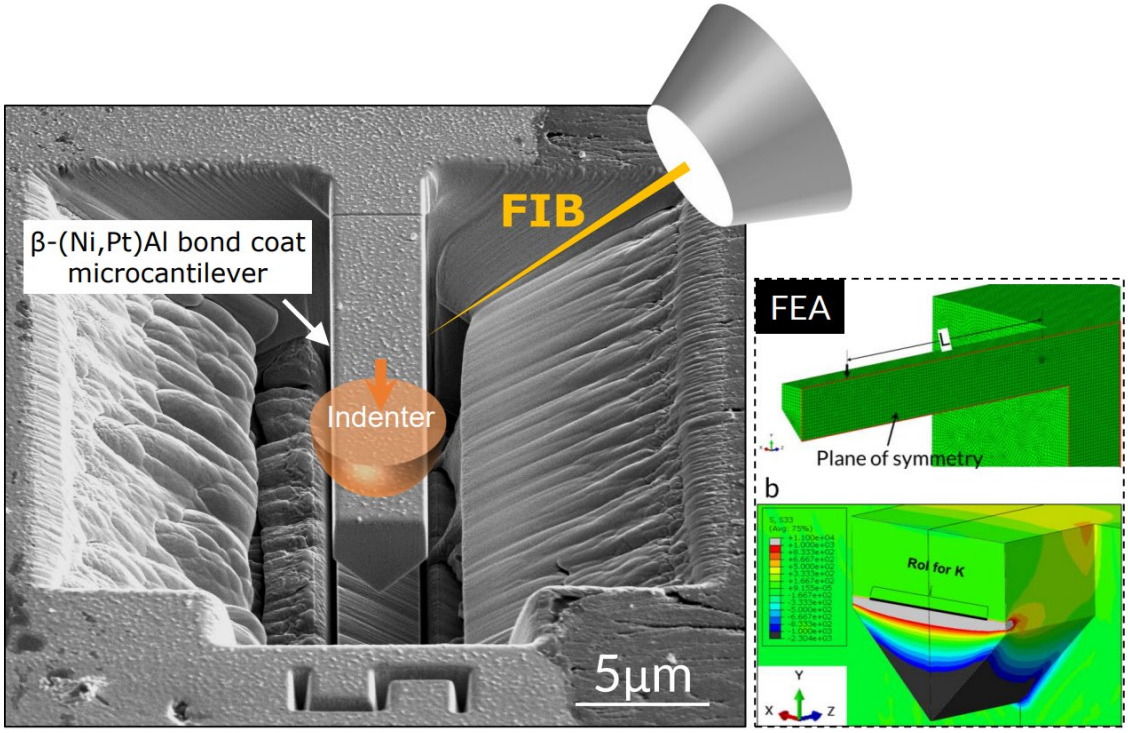

Figure 1 – Micromechanical testing of a β-(Ni,Pt)Al bond coat for determining its fracture toughness