Deformation Behavior of Multilayered Metal-Ceramic Nanocomposites

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Small-length scale multilayered structures are attractive materials because of their extremely high strength and flexibility, relative to conventional laminated composites. In this talk we present results on nanolayered laminated composites of Al and SiC. The laminated composites were fabricated by physical vapor deposition (magnetron sputtering) of alternate layers of Al and SiC, Fig. 1. The microstructure of the multilayered structures was characterized by transmission electron microscopy (TEM). The mechanical properties of the layered materials were characterized by nanoindentation and tensile testing. Tensile testing was conducted on a high-resolution micromechanical testing system. The influence of layer thickness on hardness and Young's modulus of individual layers was quantified. The Young's modulus and tensile strength of the composites were also measured. Finite element modeling was conducted to elucidate the stress state under indentation, Fig. 2. Note the heterogeneous stress state below the indenter, and the relatively large stress in the SiC layers. The important implications of the heterogeneous stress state, during indentation, to measurements of modulus and hardness will be discussed.

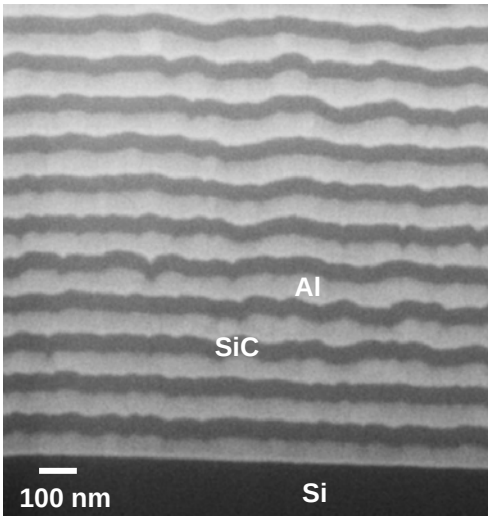

Fig. 1. Microstructure of multilayered nanocomposite of Al and SiC.

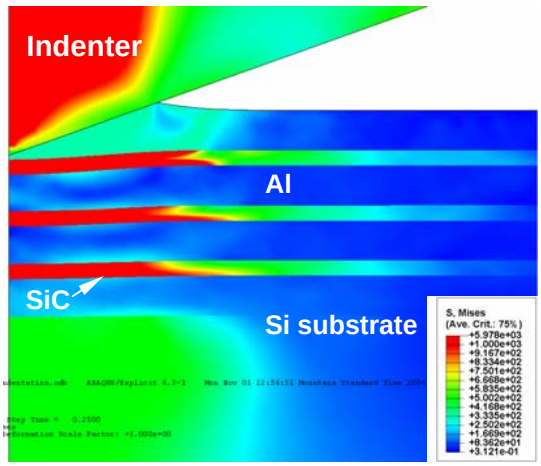

Fig. 2. von Mises stress distribution in multilayer during indentation from FEM model.