

CONTROL AND MEASUREMENT OF INTERFACE STRENGTH IN THE NIOBIUM-ALUMINUM OXIDE SYSTEM USING ION BEAM ASSISTED DEPOSITION, G. S. Was, H. Ji, Cooley Bldg., University of Michigan, Ann Arbor, MI 48109, and N. Moody, Sandia National Laboratory, Div. 8712 MS 9403, Livermore, CA 94551

The interface plays an important role in the toughness of metal-ceramic multilayer systems. The toughness of a niobium-aluminum oxide multilayer depends on the interface strength, which can be controlled by both the orientation relationship of the constituents and the composition at the interface. As a first approximation to multilayers, niobium films were deposited onto (0001) sapphire substrates by ion beam assisted deposition (IBAD) under various conditions. In addition to the (110) fiber texture, a strong in-plane texture was introduced by simultaneous ion bombardment. Stronger in-plane texture was developed with higher ion energy and higher ion to atom arrival rate ratio (R ratio). Different orientation relationships at the niobium - sapphire interface were achieved by varying the orientation of the sapphire substrates with respect to the ion beam incident direction. The mechanical properties (hardness and modulus) of the niobium layer were also modified by the ion bombardment. A dopant (Ag) was introduced at the interface at levels from a fraction of a monolayer to several monolayers prior to or during niobium layer deposition. The interfacial toughness was measured by scratch test and indentation test performed using a nanoindenter. The results are related to the dopant level, orientation relationship and the metal layer properties.

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