INFLUENCES OF INTERFACIAL ADHESION ON THIN FILM MECHANICAL PROPERTY MEASUREMENT BY NANOINDENTATION

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ABSTRACT

Experiments have been performed on soft aluminum films deposited on hard ceramic substrates to explore the influences of interfacial adhesion on mechanical property measurement by load and displacement sensing indentation methods such as nanoindentation. The substrate materials included soda-lime silicate glass, aluminum oxynitride (ALON), and a-axis sapphire, on which thin films of aluminum were sputter deposited under nominally identical conditions to a total thickness of 500 nm. The only major structural difference in the specimens was the nature of the substrate, which exerts a strong influence on film adhesion through interfacial chemistry. Aluminum adheres strongly to glass and sapphire, but poorly to ALON. In addition, two different types of films were prepared on sapphire substrates: one with and the other without a ~10 nm interlayer of amorphous carbon to reduce film adhesion. Nanoindentation testing of the various materials revealed significant differences in their mechanical behavior, suggesting that nanoindentation could prove useful in studying and characterizing the adhesion of soft films on hard substrates. Characterization of the residual hardness impressions by high resolution scanning electron microscopy and atomic force microscopy showed that the differences arise from the influence of interfacial debonding on plasticity in the film. Results of the experiments are documented and discussed.

KEYWORDS

Aluminum, glass, sapphire, thin films, adhesion, nanoindentation.