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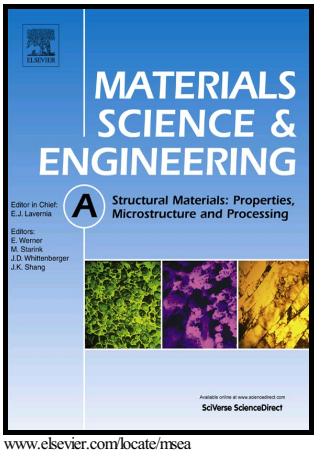

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In-situ observations of the fracture and adhesion of Cu/Nb multilayers on polyimide substrates

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Abstract

Cu/Nb nanoscale metallic multilayers have been extensively investigated to understand how their mechanical behavior is influenced by the individual layer thickness. The general observed trend is that the yield stress of the multilayer increases with decreasing layer thickness. Important mechanical behaviors that have not been studied in-depth are the fracture of these multilayers and adhesion energy between the multilayer films and their substrate. Here, the influences of the layer thickness, layer order, and initial residual stresses of Cu/Nb multilayers on polyimide were examined using in-situ x-ray diffraction and confocal laser scanning microscopy under tensile loading. With these techniques, it was possible to calculate the stresses developing in the individual materials and measure buckles that could be used to evaluate the interfacial adhesion. Layer thickness, deposition order, and the initial residual stresses were not shown to influence the initial fracture strains of the Cu/Nb multilayer systems under tensile loading conditions. However, the adhesion energy between the multilayer and substrate was affected by the layer deposition order and by the initial residual stresses.

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