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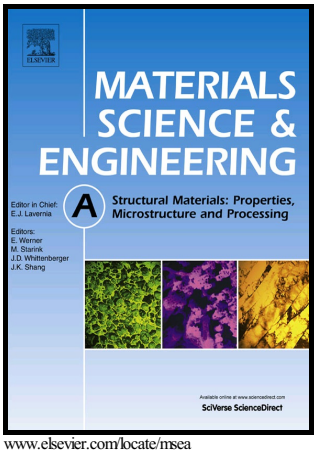


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# Enhanced hardness via interface alloying in nanoscale Cu/Al multilayers

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## Abstract

Ultrahigh hardness (yield strength) was achieved in magnetron sputtering nanoscale Cu/Al multilayers upon annealing. The microstructure and mechanical properties of the multilayers were systematically investigated by X-ray diffraction, transmission electron microscopy, energy dispersive X-ray spectroscopy and nanoindentation. Annealing promoted diffusion of Cu and Al atoms in the interfaces and the sharp interface turned to mix, resulting in the formation of Cu/Al intermetallic compounds and its deformation at nanoscale. The Cu/Al intermetallic compounds mainly including $Al_2Cu$ grew toward to Al layers and would reducing the effective length between the reduced adjacent layers. As the annealing temperature was increased from 100℃ to 500℃, various kinds and larger size Cu/Al intermetallic compounds emerged, causing the hardness to first increase, reaching an unusually high peak (never reached before in other thin metallic multilayer systems), and then remain