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Interfacial roughness and proximity effects in superconductor/ferromagnet CuNi/Nb heterostructures

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Abstract

© 2015 AIP Publishing LLC. We report an investigation of the structural and electronic properties of hybrid superconductor/ferromagnet (S/F) bilayers of composition Nb/Cu60Ni40 prepared by magnetron sputtering. X-ray and neutron reflectometry show that both the overall interfacial roughness and vertical correlations of the roughness of different interfaces are lower for heterostructures deposited on Al2O3(1 1 ¯ 02) substrates than for those deposited on Si(111). Mutual inductance experiments were then used to study the influence of the interfacial roughness on the superconducting transition temperature, TC. These measurements revealed a ~4% higher TC in heterostructures deposited on Al2O3, compared to those on Si. We attribute this effect to a higher mean-free path of electrons in the S layer, caused by a suppression of diffusive scattering at the interfaces. However, the dependence of the TC on the thickness of the ferromagnetic layer is not significantly different in the two systems, indicating a weak influence of the interfacial roughness on the transparency for Cooper pairs.

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