Neutron reflectometry studies of Gd/Nb and $Cu_{30}Ni_{70}$/Nb superlattices

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Abstract. We performed a comparative study of magnetic proximity effects in $[Gd(5nm)/Nb(25nm)]_{12}$ and $[Cu_{30}Ni_{70}(6nm)/Nb(27nm)]_{12}$ superlattices of S/F type by means of transport measurements and neutron scattering. Transport measurements have shown that Gd/Nb and CuNi/Nb superlattices shows 3D and 2D type of superconductivity respectively. In the case of proximity coupled Gd/Nb superconductor the effective thickness of the superconducting region, 300nm is enough to expel significant amount of applied magnetic field which was detected by neutron scattering. In decoupled CuNi/Nb superlattice thickness of every superconducting layer is only 27nm which is not enough to expel applied magnetic field. Our study shows how neutron reflectometry can be applied to study proximity coupling in superconducting/ferromagnet heterostructures.

1. Introduction

Artificial superconducting/ferromagnet (S/F) heterostructures are attracting nowadays great attention due to rich proximity effect physics arising in them [1-8]. In addition to scientific interest to the rich physics in S/F heterostructures there is also a growing interest to the application of these structures in superconducting spintronics [9-11] including such new approaches as neuromorphic computing [12,13]. At the moment most efforts are focused on simple S/F structures while usage of more complex S/F systems, such as $[S/F]_n$ (n>>1) superlattices (SL) may bring essentially new properties.