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Multilayered Ferromagnet/superconductor Nanostructures: Proximity Effect, Decoupled Superconductivity, and Hierarchy of Critical Temperatures

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The four- and five-layered nanostructures consisting of rather dirty superconducting (S) and ferromagnetic (F) metals have been studied within the theory of the proximity effect taking into account the microscopically derived boundary conditions [1-4]. Superconductivity in these structures is a superposition of the BCS pairing with zero total momentum in S layers and the Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) pairing with nonzero 3D coherent momentum k in F layers. The extra pi phase superconducting states obtained for the four- and five-layered F/S nanostructures have been found to be different from the analogous pi phase superconducting superlattice states. The dependence of critical temperatures versus the F layers thicknesses have been explored for a wide range of parameters, and a physically interesting range of their values has been determined. The predicted hierarchy of critical temperatures has been shown to manifest itself mainly through the occurrence of different critical temperatures in different S and S' layers (space-separated or decoupled superconductivity). The complicated phase diagrams of these nanostructures have been constructed, explored, and compared with the ones for earlier studied F/S structures (bilayers, trilayers, and superlattices). The inverse action of superconductivity on magnetism has been shown to lead to preferable mutual antiferromagnetic orientation of magnetizations of the F and F' layers, if the inner S layer is in the superconducting state. An optimal set of parameters has been determined for the case when the difference between critical temperatures for different superconducting layers becomes significant. A conceptual scheme of a control device with superconducting and magnetic recording channels that can be controlled separately using a weak external magnetic field is proposed on the basis of the four- and five-layered nanostructures.

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DC09

Structural and Physical Studies of Silver Added Bi-(2223) High-T_c Superconductors

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The samples with nominal composition $Bi_{1.6}Pb_{0.4}Sr_2Ca_2Cu_3Od$ were prepared by the conventional solid-state reaction method. The effect of silver (Ag_2CO_3) addition (0-25 wt%) on the powder has been investigated. Characterizations included X-ray diffraction, scanning electron microscopy, dc electrical resistivity, critical temperature, ac magnetic susceptibility and critical current density. The room temperature X-ray diffraction patterns of all the samples indicated the presence of large amount of Bi-(2223) phase along with minor amount of Bi-(2212) phase. The lattice structure of the material belongs to the orthorhombic unit cell. The volume fraction was estimated from the intensities of Bi-(2223) and Bi-(2212) phases. The sample with 5 wt% of added Ag shows the higher volume fraction of Bi-(2223) phase formed (86%). The dc electrical resistivity of all the samples decreases as the wt% of Ag increases. Both the onset critical T_c(onset) and zero electrical resistivity T_c(R=0) temperatures were determined from the dc electrical resistivity and ac magnetic susceptibility measurements, which remains within the temperature range 110-113 ± 1 K and 101-106 ± 1 K respectively. Resistivity data agrees with ac magnetic susceptibility measurements. The critical current density for the 25 wt% Ag doped samples increased by 3-times compared to the un-doped sample.