Superconducting Proximity Effect in Lateral S/F and F/S-F-S/F Mesoscopic Heterostructure

Dong-Keun Ki[1], and Hu-Jong Lee[1,2]

[1]Department of Physics, Pohang University of Science and Technology, Korea

[2]National Center for Nanomaterials Technology, Pohang 790-784, Korea

Superconducting proximity effect at an interface between superconductor (SC) and conventional itinerant ferromagnet (FM) is experimentally investigated. In general sense, proximity effect should be short-ranged in FM because the large exchange energy splits momentum of spin-up and spin-down electrons in a Cooper pair. However, some observations have shown an anomalously large resistance change in FM/SC structures, which leads to the suggestion of spin-triplet superconducting pairing for the origin of this long-range proximity effect. In addition, theoretical proposals to generate and measure the spin-triplet pairing in particular FM/SC structures have been developed so far. Nevertheless, early experiments with conventional FM's could also be explained by the other effects like current or magnetic-domain redistribution at a FM/SC junction rather than the long-range proximity effect. Therefore, no clear experimental proof for the spin-triplet pairing state is available since the R. S. Keiser's work [1]. The authors in [1] observed a long-range supercurrent flowing through a half-metal between two superconductors, but the observation was in discrepancy with theoretical predictions. Thus, no convincing theories to explain the effect exist yet. In this report, we investigated the differential resistance as a function of bias current, magnetic field and temperature in conventional FM and SC junctions arranged in different geometries. Results showing possible long-range proximity effect in FM/SC-FM-SC/FM structures will be presented.

[1] R. S. Keizer et al., Nature, 439, 825 (2006)