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Giant positive magnetoresistance in Co@CoO nanoparticle array[1]

HUI XING, WENJIE KONG, CHAEHYUN KIM, University at Buffalo-SUNY, SHOUHENG SUN, Brown University, ZHUAN XU, Zhejiang University, HAO ZENG, University at Buffalo-SUNY — The spin-dependent charge transport has been extensively studied due to its technological applications in information industry. Of particular interests are magnetic granular systems consisting of magnetic grains embedded in a nonmagnetic matrix, which typically exhibits negative granular MR. Interestingly, anomalous positive MR in granular systems has been reported in different materials [1]. Possible origins that can account for the positive MR include: ordinary MR caused by the curving of the carrier trajectories in the magnetic field6, shrinkage of the wave functions of localized electronic states due to the external field7, and suppression of hopping paths due to the Zeeman splitting of the localized state8. Here we present magnetotransport studies in self-assembled Co@CoO nanoparticle arrays which provide model granular systems. Efros Shklovskii variable range hopping to Mott variable range hopping crossover occurs at around 25K. Giant positive MR with its saturation field increasing with increasing temperature is observed, and is well explained by the Zeeman splitting of the localized states that suppresses the spin dependent hopping paths in the presence of magnetic field.

[1] K. A. Matveev et al., "Theory of hopping magnetoresistance induced by Zeeman splitting," Physical Review B **52** (7), 5289 (1995).

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