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**Electrical Transport Properties of Hybrid Magnet-Superconductor Nanostructures near the Transition Temperature** K. KIM, A.E. OZMETIN, D.G. NAUGLE, W. WU, I. LYUKSYUTOV, Department of Physics, Texas A&M University, College Station, TX77843-4242 — Magnetic hysteretic behavior of the magnetoresistance and the critical current is observed in a hybrid magnet-superconductor nanostructure (MSN) in which vertically aligned nickel nanorods in a square lattice are partially embedded in a $Pb_{82}Bi_{18}$ film. From mean field theory and the measured hysteresis curve of the magnetic nanostructure unusual hysteretic behavior of the phase diagram in this MSN system is predicted. The phase diagram for the hybrid MSN obtained from resistive measurements of $Hc_2$ is compared with the theoretical prediction. Other observed effects with the MSN, such as the matching effect and strong flux pinning are presented. Cusps and kinks appear at specific applied magnetic fields. The values of fields are consistent with the matching fields. The critical current in the strongest pinning regime of the hybrid system is up to about three orders of magnitude higher than the critical current of the $Pb_{82}Bi_{18}$ control film. Work supported by DOE No. DE-FG02-07ER46450, NSF CHE-0809651, NSF No. DMR-0606529, the Robert A. Welch Foundation A-0514 and A-1688, and NHARP under grant # 010366-0039-2007.

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