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Magnetic and Transport Properties of Co Nanoparticles Fabricated With a Cluster Gun[1] P. LIU, M.J. BONDER, Y. HUANG, Y. ZHANG, G.C. HADJIPANAYIS, Department of Physics and Astronomy, University of Delaware, D. VLACHOS, S.R. DESHMUKH, Department of Chemical Engineering, University of Delaware — Cluster guns have been found to be suitable for the fabrication of nanoparticles in a wide range of materials with the additional advantage of in-situ processing (annealing, surface passivation, etc.) of the nanoparticles inside the sputtering chamber [1, 2]. In this study, we look to optimize parameters for fabricating Co nanoparticles and embed them in a carbon matrix. Magnetic and transport properties are measured over a wide temperature range. The size and distribution of the nanoparticles can be controlled by varying the target-orifice distance, Argon pressure, sputtering time and Co magnetron power. At the lowest power used the Co nanoparticles are less than 5nm in size. At this size thermomagnetic measurements indicate a blocking temperature of 115 K indicative of superparamagnetism in this sample. As the power is increased there is an increase of the blocking temperature commensurate with the increase in nanoparticle size as seen in bright field electron microscopy. The transport studies of these samples show a cross-over from metallic to semi-conducting behavior as the inter-particle spacing is varied. The origin of the cross-over is under investigation and the results will be reported. [1] Stoyanov S, et al., J. Appl. Phys., 93 (10): 7190 (2003). [2] Skumryev V, et al., Nature, 423 (6942): 850 (2003).

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