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Collective Magnetic Behavior in Surface-supported Nanodot Assemblies

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In this talk, I will discuss several novel methods for synthesizing surface-supported magnetic nanodot assemblies. I will then report collective ferromagnetic behavior in two-dimensional Fe dot assemblies on the Cu(111) surface that persists above room temperature. Our ability to tune the average size and spacing of the dots enables us to investigate the relative contributions of the mechanisms that support this unexpectedly robust magnetic order. Our experimental results and simulations indicate that the high-Tc ferromagnetism cannot be explained by either magnetic anisotropy or the simple dipolar interaction. Therefore, the ferromagnetic order in the Fe dot assemblies is a result of an indirect exchange interaction via the Cu(111) substrate. New experimental evidence indicates that the indirect exchange interaction is mediated by the surface electronic states on Cu(111).

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Thermal and transport properties of a single nickel nanowire

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The thermal conductivity (κ), specific heat (Cp) and the resistivity (ρ) of a single nickel nanowire have been measured in the temperature range from 4 to 300 K by means of the "self heating 3ω" technique. Starting with a 100 nm nickel film grown on a Si_3N_4/Si substrate by thermal evaporation, a suspended nickel nanowire was then fabricated through e-beam lithography and etching processes. The width and length of the wire were determined by scanning electron microscope (SEM) as 180 nm and 35 μm re-spectively. At 300 K the thermal conductivity of nanowire is ~ 20% of the bulk, it diminishes to lower value as temperature decreases. The consequence is opposite to that of the bulk and might be explained by the ristriction of mean free paths of electron/phonon-phonon interactions due to the grain boundaries. An enhancement of specific heat ~200% of the bulk is also observed. In addition, the resistivity of nanowire at room temperature is about four times larger than that of the bulk. The small relative resistiv-ity ratio (RRR) confirms the polycrystalline characteristic of the nanowire. The magnetic field depend-ence of $\kappa(T)$, $C(T)$, and $\rho(T)$ will also be discussed.