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Hall-Coefficient and Resistivity at High Pressure in 1T-TaS2

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BH 5 A New Class of Layered Materials: Layered Ultra-Thin Coherent Structures (LUCS). IVAN K. SCHULLER, K. MEYER* and CHARLES M. FALCO, Argonne National Lab.**--We describe a new class of superconducting materials, Layered Ultrathin Coherent Structures (LUCS). These materials are produced by sequentially depositing ultra-thin layers of materials using high rate magnetron sputtering or molecular beam evaporation. We present strong structural evidence (Auger and X-rays) that layers as thin as 10 Å can be prepared in this fashion. The superconducting properties (critical field, transition temperatures, etc.) are found to be similar to those of layered compounds, although the coupling in between layers is strong. This is interpreted as layering induced changes in the electronic structure of the LUCS constituents.

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BH 6 Low Temperature Electrical Properties of TiS_2. B.J. BLUMENSTOCK, P.A. SCHROEDER, Michigan State U.* C.A. Kukkonen, W.J. Kaiser and E.M. Logothetis, Ford Motor Co.--Electrical resistivity, Hall coefficient and magnetoresistance of $Ti_{1+x}S_2$ single crystals with $x < 0.06$ have been measured between 1 and 100 K. The resistivity of these crystals is of the form $\rho = \rho(0) + \rho(T)$, where the residual resistivity $\rho(0)$ varies with the electron concentration as $n^{1/3}$. This dependence is consistent with impurity scattering where the scatterers are also the source of the carriers. It was previously reported that between 77 and 700 K, $\rho(T)$ varied as T^m where m was between 1.85 and 2.3 depending on stoichiometry. The present measurements show that below 50 K, $\rho(T)$ of all samples is close to T^3. A temperature dependence with a power higher than T^2 at low T is characteristic of phonon scattering; however the simple Bloch-Grüneisen theory predicts T^5 at the lowest temperatures whereas the observed dependence remains T^3 to at least 1.5 K.

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BH 7 Hall Coefficient and Resistivity at High Pressure in $1T-TaS_2$. P. D. HAMBOURGER, Cleveland State U., and F. J. DI SALVO, Bell Laboratories. --The Hall coefficient (R_H) and resistivity (ρ) of $1T-TaS_2$ have been measured over the range $1.5<T<290$ K under hydrostatic pressure of 6.4 kBar. At this pressure the sample remains in the "quasicommensurate" charge-density-wave state[1] over our entire temperature range.[2] R_H varies monotonically from $\sim -6x10^{-4}$ cm^3/C at 290 K to $\sim -2x10^{-3}$ cm^3/C at 1.5 K. $\partial\rho/\partial T$ is negative over most of the temperature range, with $\rho(1.5\ K)/\rho(290\ K)\sim 3$. ρ is essentially temperature-independent for T<30 K. The data suggest that conduction at low temperatures is not by hopping as appears to be the case in the commensurate state.[1,3,4]

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BH 8 Band Structure and Interlayer Interactions of Thin Films of Transition Metal Dichalcogenides: TiS_2 and ZrS_2.* CYRUS UMRIGAR, D.S. WANG, D.E. ELLIS, H. KRAKAUER and M. POSTERNAK+, Northwestern U.--The potential field in the Van der Waals gap between adjacent MX_2 sandwiches in the layered transition metal dichalcogenides plays an important role in determining ionic transport of intercalates. The self-consistent energy bands, local density of states, work functions and charge density of thin films of the layered transition metal dichalcogenides TiS_2 and ZrS_2 are calculated by the LAPW method.[1] The results of calculations on single sandwich and double sandwich films are compared. The Coulomb potential in the gap is mapped as an aid in studying ionic transport in these materials. The electronic structure of the intercalated system (TiS_2)-Li-(TiS_2) is explored.

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BH 9 Electrical Transport Properties of $Fe_xNi_yNbSe_2$. ALLAN T. MITCHELL and R.C. MORRIS, Florida State U.*--A study of the Hall coefficient and resistivity of $Fe_xNi_yNbSe_2$ has been done for x and y in the range 0-0.33 for temperatures 4-300K. Whereas Ni_xNbSe_2 for $x < 0.15$ shows little or no behavior which can be associated with the interaction of a Ni moment with the conduction electrons, small concentrations of Ni in $Fe_xNi_yNbSe_2$ result in pronounced changes in the low temperature Hall coefficient from that of $Fe_{x+y}NbSe_2$ indicating an enhanced magnetic scattering due to the Ni. Higher concentrations of Ni affect both transport properties and give additional indication that the Ni and Fe impurities do not act independently but rather that the magnetic character of the Ni is strongly influenced by the presence of the Fe. A comparison of the properties of the three systems will be presented to give an overall picture of the magnetic character of the Fe and Ni in this anisotropy matrix, the interaction between the two impurities, and interaction of the impurities with the charge carriers.
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BH 10 Intrinsic Paramagnetic Moments in $1T-TaS_2$. F. J. DISALVO and J. V. WASZCZAK, Bell Laboratories - Recently Fukuyama and Yosida[1] suggested that the low temperature magnetoresistance of $1T-TaS_2$ could be explained if both Anderson localization and electron correlations are included. This leads to a net paramagnetic localized spin density. We show that high purity $1T-TaS_2$ has a low temperature (6-85K) susceptibility $\chi = 0.80 \times 10^{-6}/(T-0.4) -0.196 \times 10^{-6}$ (emu/g), that can not be explained by the measured low levels of impurities. The impurities were: Fe (5-10ppm), Ni(1-5ppm), Cu(1-5ppm). Further, Fe is non magnetic in $1T-TaS_2$ at low temperatures.[2] Below 4K the susceptibility becomes non-linear in magnetic field, with an extrapolated non zero magnetization at zero field. Other results and models will be presented.
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BH 11 NMR Studies in H_xTaS_2 and D_xTaS_2. T. R. HALBERT, A. J. JACOBSON, R. L. KLEINBERG, and B. G. SILBERNAGEL, Exxon Research and Engineering Co. --Recent neutron diffraction studies of H_xTaS_2 layered compounds indicate the inclusion of protons into the layers of the TaS_2 host.[1] The present wideline and transient NMR results reflect the strong coupling of hydrogen atoms with their environment expected in such circumstances. H_xTaS_2 and D_xTaS_2 materials with a composition of x = 0.34 were prepared electrochemically and their structure was verified by x-ray diffraction. Wideline studies of the ^2D NMR absorption indicate a substantial coupling constant: $e^2qQ/h \sim 68$ kHz. The field gradient at the site of the ^2D nucleus is $\sim 10V/Å^2$, roughly one thousand times larger than observed for Li_xTaS_2, where the Li species resides outside of the layers of the TaS_2 host material. Transient measurements of the ^1H spin lattice relaxation in $H_{0.34}TaS_2$ reveal a Korringa-like behavior for temperature between 150 K and 300 K, with $T_1T \sim 100$ sec-K. This magnitude is comparable to that in Li metal (~ 43 sec-K), suggesting relatively strong coupling with the electrons