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(J. S. KOUVEL presiding)

Magnetism IV

FG 1 Magnetic Susceptibility of the 1-T and 2-H Modifications of TaS_2.* A. MENTH, Bell Tel Labs, T. H. GEBALLE, Bell Tel Labs and Stanford Univ., and F. R. GAMBLE, Synvar Research Institute -- TaS_2 is a layered compound which occurs in different modifications. One of them, the 1-T phase has been reported to show semiconducting behavior below 350 K with an additional semiconductor to semiconductor transition around 180 K. In the semiconducting region 1-T TaS_2 is diamagnetic with a decrease of the diamagnetic susceptibility by a factor 2 at 180 K with increasing temperature. At 310 K, the susceptibility changes discontinuously from diamagnetic to paramagnetic. The step corresponds to the Pauli-susceptibility of about 1 el per molecular unit. Above 380 K the paramgnetic susceptibility increases reversibly with temperature until it reaches the value of metallic 2-H TaS_2 around 500 K. Upon cooling from above 500 K the 2-H behavior is retained. Single crystalline 2-H TaS_2 is paramagnetic (10 times stronger than the 1-T phase at 320 K) at all temperatures with a slight increase of the susceptibility with decreasing temperature.

*Work at Stanford supported in part by grant AOFSR 68-1510 C.

FG 2 Thermal Conductivity of $RbMnF_3$ in a Magnetic Field.* M. S. WALKER** and S. A. FRIEDBERG, Carnegie-Mellon Univ.--We have measured the thermal conductivity, K, of three crystalline specimens of $RbMnF_3$ between 1.3 and 77°K. In two cases the direction of heat flow is along [010]. K was measured with magnetic fields up to 12.5 kOe applied along numerous directions in the (010) and (101) planes. $\Delta K/K_0$ exhibits pronounced anisotropy when the field is rotated in these planes for T < 20°K. For H in a given direction at all but the lowest temperatures, $\Delta K/K_0$ appears to follow the change in sublattice orientation[1] produced by increasing H. For the purer specimens, the anisotropy and H dependence of $\Delta K/K_0$ bear striking resemblance to those of the Zeeman splitting in optical spectra.[2] Near 1.3°K, $\Delta K/K_0$ may reflect field dependent changes in the magnon spectrum.

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[1]P. H. Cole and W. J. Ince, Phys. Rev. 150, 377 (1966).
[2]V. V. Eremenko, V. P. Novikov, Yu. A. Popkov, JETP 54, 1037 (1968); Soviet Physics JETP 27, 553 (1968).

FG 3 Spin Wave Conductivity in Antiferromagnetic Cobalt Chloride Thiourea, $CoCl_2[(NH_2)_2CS]_4$*. C. NI and H. WEINSTOCK, IIT--Thermal conductivity measurements on cobalt chloride thiourea have been carried out over a range from 0.35 K to 15 K, and as a function of magnetic field and direction of heat flow. In conjunction with theoretical calculations which show that excitation of spin waves is energetically possible. these have been analyzed to show the probable existence of spin wave conduction below the Néel temperature of 0.92 K when heat flows along the direction of sublattice magnetization. For a specimen with heat flowing normal to the direction of sublattice magnetization, no evidence of a spin wave contribution to the over-all conductivity has been observed.

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FG 4 Rotational Effects in Magnetoelastic Phenomena. R. L. MELCHER, IBM Watson Research Center.--Rigorous application of rotational invariance to the stored energy of a magnetoelastic system leads to the result that the rotational component as well as the strain component of an elastic shear wave can couple linearly to the magnetic modes. The rotational coupling becomes important in systems which have a high magnetic anisotropy. Experiments performed on the anisotropic antiferromagnet MnF_2 demonstrate unambiguously the effect of rotational coupling.[1] These results are in direct contradiction to conventional magnetoelastic theory which considers only the coupling of the magnetic modes to the elastic strain. Investigation of coupled elastic, electronic spin and nuclear spin modes in an anisotropic antiferromagnet reveals again that rotational effects should be important. An experiment will be proposed to test this result.

1. R. L. Melcher, Phys. Rev. Letters 25, 1201 (1970).

FG 5 NMR Spin Echo Study of Ni^{61} in Natural Nickel. J. R. ASIK and MARY BETH STEARNS, Sci. Res. Staff, Ford Motor Co.--The NMR of Ni^{61} in pure nickel powder has been studied by the spin echo method at 1.3, 4.2, and 77°K in order to measure T_1, T_2, and the enhancement factor ε. The effect of annealing, cold work, sample purity, and particle size has been determined. Comparison has been made with the theory developed by Stearns[1] which has been applied successfully to Fe^{57} in iron. For annealed high purity nickel, the theory accounts well for ε and T_2 but not for T_1. The maximum enhancement factor ε_0 is found to be 4000 ± 500, independent of temperature. We find the transverse relaxation rate to vary linearly with temperature; $T_{02}T$ = 4.5 ± 1.0 ms-°K, where T_{02} is the minimum T_2. Although the theory does not account for the T_1 relaxation, it appears that the longitudinal relaxation rate deviates significantly from a linear T dependence. We find that $T_{01}T^n$ = 6.5 ± 1.5 ms-°K, where n = 0.8 ± 0.1. Cold work reduces ε_0 to approximately 200 and increases T_1 by a factor of 4 to 10 and T_2 by a factor of 2 to 4, depending on the turning angles.

1. M. B. Stearns, Phys. Rev. 187, 648 (1969).

FG 6 Explanation of Hyperfine Fields at Solute Atoms in Fe. MARY BETH STEARNS, Sci. Res. Staff, Ford Motor Co.--The hyperfine fields, H_z, at solute atoms in Fe (Co or Ni) show regular variations as a function of atomic number Z. In general $H_z = H_n + H_m + H_v$ where H_n is a negative term due to conduction electron polarization by Fe neighbors. H_n can be evaluated from the known value of H_n^{Fe} (~ -145 kG)[1] and the hyperfine field constants. H_m is non-zero when the solute atom has a moment and is then due to the solute atom core polarization and self-polarization of the conduction electrons. It has been evaluated previously[2] in regions near the ends of d-transition series where the solute atom develops a moment. For non-transition series elements H_m = 0, so we can find H_v directly. It is found to be due to a positive polarization induced in an outer ns electron (in a virtual bound state) of the solute atom and is proportional to the volume overlap of the atomic volume of the solute atom with the Fe matrix.

1. M. B. Stearns, 16th Annual Mag. Conf., Miami Beach (1970).
2. D. A. Shirley, S. S. Rosenblum and E. Matthais, Phys. Rev. 170, 363 (1968).

FG 7 The High Pressure Phase Transition and Demagnetization in Shock Compressed Fe-Mn Alloys.* A. CHRISTOU and N. BROWN, LRSM, Dept. of Met., Univ. of Penn.--Shock deformation of Fe-Mn alloys up to 14 wt. pct. Mn results in a shock induced phase transformation. It has been shown that BCC martensite with manganese in the range