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Neutron Diffraction and Frequency Dependence of the A.C. Susceptibility of the System $ZnCr_{2x}Al_{2-2x}S_4$

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AS-15. NEUTRON DIFFRACTION AND FREQUENCY DEPENDENCE OF THE a.c. SUSCEPTIBILITY OF THE SYSTEM $ZnCr_{2x}Al_{2-2x}S_4$. M. Hamedoun, A. Hourmatallah, N. Benzakour (Université Sidi Mohammed Ben Abdellah. Faculté des sciences Dhar Mahraz. Laboratoire de Physique du Solide. B.P. 1796 Fes Maroc), K. Mediouri, J. Ilali (C.N.E.S.T.E.N. Agdal. Rabat Maroc), W. B. Yelon, and H. Luo (Res. Reactor Ctr., Univ. of Missouri-Columbia, Columbia, MO 65211)

In order to establish the nature of the ordering and the transition PM-SG in the spinel $ZnCr_{2x}Al_{2-2x}S_4$, we have performed a neutron diffraction study on D1A (ILL) and MURR diffractometers in the range $0.5 \leq x \leq 1$ and a low field a.c. susceptibility measurement for $x=0.5$. For $0.85 \leq x \leq 1$, a helimagnetic ordering builds up below the Neél temperature T_N which is transformed at T_0 into a mixed phase. For $x<0.85$, apart from the nuclear Bragg peaks, neutron scattering patterns only display a very broad peak at $Q=0.49$ Å^{-1}. The intensity of this peak increase when T decreases and becomes broader. It is attributed to the progressive onset of magnetic short range order S.R.O. and confirms a presumed spin glass state below T_f. The evolution of the S.R.O. is continuous across T_f. The dynamic freezing of the moments is not correlated with a saturation of $\zeta(T)$ below T_f as was observed in other SG system. To study the PM-SG transition, magnetic susceptibility behavior is studied in weak a.c. magnetic fields for $x=0.5$. The freezing temperature T_f taken as the temperature corresponding to the maximum of $\chi(\nu)$ depends on the measurement frequency. We have checked the power law $\tau=\tau_0\{[T-T^*]/T^*\}^{-z\nu}$ and the Vogel Fulcher law $\tau=\tau_0\exp[E_a/K(T-T_0)]$. The obtained values $\tau_0=10^{-12}$ s and $z\nu=7$ are in agreement with theoretical values and many spin glasses for which the existence of a phase transition at finite temperature is confirmed by static measurements. The obtained values for T_0 and E_a are 5.9 K and 21.5 K, respectively.

AS-16. MAGNETIC TRANSITION IN $Ga_{0.6}Mo_2S_4$ SPINEL. T. Taniyama and I. Nakatani (Natl. Res. Inst. for Metals, Tsukuba 305, Japan)

We present results of the magnetization measurements on chalcogenide spinel cluster compound $Ga_{0.6}Mo_2S_4$. The magnetic nature of $Ga_{0.6}Mo_2S_4$ is discussed on the basis of the results. We used a well characterized single phase polycrystalline sample with a space group of $F\bar{4}3m$ at room temperature. The magnetization measurements were performed at temperatures from 2 K to 25 K under zero field cooled (ZFC) and field cooled (FC) conditions. The thermoremanent magnetizations (TRM) were recorded over four decades of time after field cooling procedure ($H=50$ Oe). Temperature irreversibility between the ZFC and FC magnetization develops just below the ferromagnetic transition temperature ($T_x=17.4$ K) determined by ac susceptibility measurements. The magnetization shows no saturation even in 90 kOe. The time dependent TRM decays in the logarithmic form below 8 K and in the stretched exponential form near the Trs_c. The extracted temperature dependence of the magnetic relaxation rate shows sharp peak at 15.0 K. These results are characteristic of highly anisotropic or random magnetic materials. The present results give the following aspect for the magnetic behaviors of the $Ga_{0.6}Mo_2S_4$. The magnetic nature in the ferromagnetic state mainly arises from the domain wall pinning which explains onset of the irreversibility of magnetization and no saturating magnetization. Further, the anisotropy is possibly related to the formation of the $4d$ magnetic molybdenum clusters.

[1]A. K. Rastogi *et al.*, J. Low Temp. Phys. **52**, 539 (1983).

AS-17. THE PHASE TRANSITION FROM THE SPIN GLASS TO THE LONG MAGNETIC ORDER AND THE NATURE OF THE SPIN GLASS PHASE IN REENTRANT SPIN GLASS $Cu_{0.625}Ga_{0.375}Cr_2Se_4$. A. I. Abramovich and L. I. Koroleva (M. V. Lomonosov Moscow State Univ., Vorobyevy Gory, Moscow 119899, Russia)

In the reentrant spin glass (SG) $Cu_{0.625}Ga_{0.375}Cr_2Se_4$[1] the dependence of the magnetoresistance (MR) $\Delta\rho/\rho$ on the magnetization square σ^2 in strong magnetic fields was studied in order to reveal a nature of SG phase and an existence of a long magnetic order (LMO) – SG state phase transition. It is known that MR is proportional to σ^2 in magnetic materials and a paraprocess intensity is described in strong field by a magnitude of slope of the $\Delta\rho/\rho(\sigma^2)$ straight line. It is evident if in reentrant SG the paraprocess intensity is the same in the SG phase and the LMO phase, these phases have not differ nearly and the SG phase consists of clusters with the same magnetic order as in the LMO phase. Listed phases differ other wise. It was found that the mentioned slope in $Cu_{0.625}Ga_{0.375}Cr_2Se_4$ was changed at the freezing temperature T_f, moreover its value was less at $T<T_f$ than one at $T>T_f$ near by a factor of 2. At the same time this slope within the such of phase does not depend on temperature almost. This fact testifies the increasing of the paraprocess intensity in LMO phase, it is evidently related with an essential restruction of the spin system at T_f. Previously next experimental facts were obtained for this compound:[1,2] the $|\Delta\rho/\rho|$ maximum at T_f, the change of the activation energy of conductivity at T_f and the independence of T_f from the magnetic field frequency in which it was measured. Thus, the obtained change of paraprocess intensity at T_f and the just listed results from Refs. 1,2 allow to come to a conclusion that in this compound a thermodynamic phase transition takes place at T_f and the SG phase is consisted of spins of separated Cr^{3+} ions.

[1]L. I. Koroleva and A. I. Kuz'minykh, Sov. Phys. JETP **84**, 1097 (1983).
[2]L. I. Koroleva and A. I. Kuz'minykh, Sov. Phys. FTT **26**, 56 (1984).