The Geometrically Frustrated Spin Glass (Fe1-Pgap)2tio5

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Spin glasses are systems in which magnetic moments freeze into randomly disordered configuration instead of long-range order below certain temperatures (). The lack of long- range order is usually thought to be a consequence of random disorders and frustrated interactions inherent in materials. However, the precise roles of disorders and frustrations in the formation of spin glasses are still controversial. In this talk, I will present our recent study on a unique spin-glass system in which the spin glass transition is observed only along the c-axis but not in the basal plane. Previous studies suggested that the anisotropic spin glass transition could be induced by a strong Ising anisotropy. However, this is inconsistent with the fact that the magnetic moment of Fe3+ is isotropic due to a half-filled d-shell. We have revisited this problem and performed diffuse neutron scattering experiments[1,2] on both Fe2TiO5 and Ga-doped compounds (Fe1-pGap)2TiO5. Our neutron experiments demonstrated that the spin transition is closely related to the formation of nano-sized surfboard-like spin clusters in these materials. And the anisotropic behavior of susceptibility is a natural consequence of inter-surfboard interaction originating from c-direction magnetic fluctuations. By performing a systematic magnetic susceptibility measurements[2], we observed that the spin glass transition temperature is uniformly suppressed by increasing p, meanwhile the value of is increased as is reduced, i.e. . In the specific heat measurements, we observed a behavior of in the low temperature limit. Our finding suggests that geometric frustration is critical in these materials, placing (Fe1-pGap)2TiO5 into a new category[3] different from the conventional spin glass dominated by disorders.

Reference

{1} P. G. LaBarre, et al., Phys. Rev. B 103, L220404 (2021).

{2} Yu Li, et al., arXiv:2207.06354 (2022).

{3} S. V. Syzranov & A. P. Ramirez, Nat. Commun. 13, 2993 (2022).