Polarized neutron scattering study of Mn_3RhSi crystal

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Conventional phase transitions are well understood in terms of the order parameter, based on the Landau–Ginzburg–Wilson theory. However, unconventional magnetic orders have been observed in clean systems such as MnSi. The unconventional magnetic orders of conduction electrons in the metallic phase has been observed for high-temperature superconductors and heavy fermion compounds. However, these unconventional magnetic orders have been limited to relatively low temperatures as quantum phase transitions. However high-temperature magnetic short-range order is observed as one of the unconventional magnetic orders at temperatures up to 720 K in a noncentrosymmetric intermetallic antiferromagnet Mn_3RhSi with a well-ordered lattice [1]. The magnetic Mn ions form a hyperkagome network of cornersharing triangles (Fig. 1), where the spins are geometrically frustrated. The spin network is equivalent to that of a spin liquid and non-Fermi-liquid material, β-Mn. Our previous observation of polycrystal sample indicates that a metallic phase with magnetic short-range order exists at high temperatures. Here, we studied the elastic component at 200 by polarized neutron scattering (Fig. 2). The large polarization ratio comparable with another nuclear Bragg peak polarization ratio suggests little magnetic component at the elastic scattering. Based on this result, the observed magnetic short-range order in Mn_3RhSi is found to be originated from the low-energy inelastic component.

[1] H. Yamauchi, D. P. Sari, I. Watanabe, Y. Yasui, L.-J. Chang, K. Kondo, T. U. Ito, M. Ishikado, M. Hagihara, M. D. Frontzek, S. Chi, J. A. Fernandez-Baca, J. S. Lord, A. Berlie, A. Kotani, S. Mori, and S. Shamoto, Commun. Mat. **1**, 43 (2020).

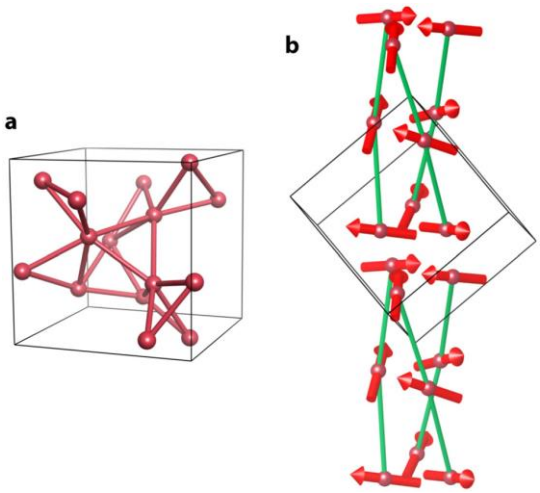

Fig. 1. Hyperkagome network of Mn magnetic sites in the cubic unit cell of Mn_3RhSi. The 12*b* site of $P2_13$ is preferentially occupied by Mn magnetic moments (**a**). Helical spin rod of triangular units along [111] (**b**). Vertical bonds correspond to the J_5 ferromagnetic interaction [1].

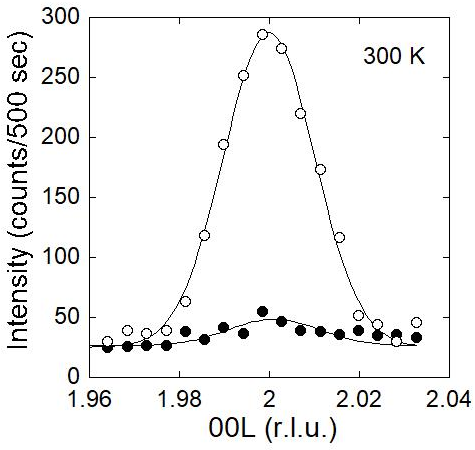

Fig. 2. Polarized neutron scattering of 200 at T= 300 K along L-scan by spin-flip (closed circles) and non-spin-flip (open circles) modes.