論文 / 著書情報
Article / Book Information

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種別(和文)	論文要旨
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論 文 要 旨

THESIS SUMMARY

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学生氏名： Student's Name	児島 佑樹	指導教員（主）： Academic Supervisor(main)	田中 秀数
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

Spin-1/2 triangular lattice antiferromagnet (TLAF) is one of the simplest frustrated quantum magnets that show remarkable quantum many-body effects, such as a one-third-magnetization plateau caused by quantum order by disorder. However, on the experimental side, there are only a few reports on the observation of the 1/3-magnetization plateau in TLAFs. Therefore, exploring new TLAFs with a 1/3-magnetization plateau remains an important and challenging task. In this thesis work, I have successfully synthesized polycrystalline samples of a TLAF $Ba_2La_2CoTe_2O_{12}$ by solid-state reaction methods. I have determined its crystal structure by X-ray and neutron diffraction experiments. I have performed low-temperature magnetic susceptibility, specific heat, neutron diffraction and high-field magnetization measurements to study the low-temperature magnetic properties of $Ba_2La_2CoTe_2O_{12}$.

The crystal structure of $Ba_2La_2CoTe_2O_{12}$ is a trigonal with space group R-3. The magnetic ions Co^{2+} with effective spin S = 1/2 form regular triangular lattice in the ab plane. The triangular lattice layers are widely separated by non-magnetic ions, leading to very weak interlayer interactions. The CoO_6 octahedra are compressed along the c axis, which produces easy-plane anisotropy. From magnetic susceptibility and specific heat data, it was found that $Ba_2La_2CoTe_2O_{12}$ undergoes three-dimensional magnetic ordering at T_N = 3.26 K. The temperature dependence of magnetic susceptibility exhibits an inflection point at 3.2 K corresponding to the onset of long-range antiferromagnetic order. The specific heat data shows a sharp peak at T_N = 3.26 K indicative of the magnetic ordering. In neutron diffraction measurements, magnetic Bragg peaks are observed below T_N. The spin structure in the ordered phase is characterized by a propagation vector $\boldsymbol{k}$ = (1/3, 1/3, 1/2), which corresponds to a 120° order state. By using classical calculations and linear spin-wave theory, it was found that the interlayer ordering is caused by a quantum order by disorder. As a result, the interlayer interaction of $Ba_2La_2CoTe_2O_{12}$ was found to be ferromagnetic. The full magnetization process of $Ba_2La_2CoTe_2O_{12}$ was measured at T = 1.3 K using a pulsed high magnetic field. The 1/3-magnetization plateau is clearly observed as expected for a quantum TLAF. The saturation of the Co^{2+} effective spin occurs in a finite field range due to the anisotropy of the g-factor. From the saturation field and saturation magnetization after the correction of the Van Vleck paramagnetism, the g-factors and exchange constant were estimated as $g_\perp$ = 4.5, $g_\parallel$ = 3.5 and J/k_B = 22 K, respectively. From these experiments, it was found that $Ba_2La_2CoTe_2O_{12}$ is magnetically described as an S = 1/2 quasi-two-dimensional TLAF with XY-like anisotropy.

I present the results on magnetic orderings and excitations in Ba_2CoTeO_6 investigated by neutron scattering experiments. Ba_2CoTeO_6 is composed of two almost isolated subsystems A and B, which are described as an S = 1/2 triangular-lattice Heisenberg-like antiferromagnet and a frustrated honeycomb-lattice Ising-like antiferromagnet, respectively. Ba_2CoTeO_6 undergoes magnetic phase transitions at T_{N1} = 12.0 K and T_{N2} = 3.0 K, which can be assigned as the orderings of subsystems B and A, respectively. Using flux method, I grew single crystals of Ba_2CoTeO_6. I co-aligned approximately 400 pieces of single crystals and conducted neutron scattering experiments. First, I confirmed the stripy ordering of subsystem B below T_{N1}, whereas I observed sharp streaks along (1/3, 1/3, L) and (2/3, 2/3, L) at 0.3 K, which is much lower than T_{N2}. This indicates that the ordering of subsystem A is two-dimensional. I found that the excitation spectra of both subsystems are well separated and independent of each other. The excitation spectrum of subsystem A is composed of two single-magnon branches with roton-like minima at the M point and a clearly structured intense continuum, as similarly observed in $Ba_3CoSb_2O_9$, which is strongly indicative of spinon excitations. I found that the excitation spectrum of subsystem A is almost the same as that of $Ba_3CoSb_2O_9$ when scaled by the exchange constant J, which shows that the excitation spectra of subsystem A and $Ba_3CoSb_2O_9$ are universal in S = 1/2 Heisenberg TLAFs. Dispersion curves for subsystem B can be described by linear spin-wave theory on the basis of a honeycomb-lattice J_1-J_2-J_3 XXZ model with a small XY component. Exchange parameters of both subsystems were determined from the dispersion curves.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).