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Neutron diffraction study of the 1/2 quantum magnetization plateau compound $Ni_2V_2O_7$

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We report on the results of powder neutron diffraction of $Ni_2V_2O_7$. Two crystallographic Ni^{2+}-ion sites carrying spin-1 exist. Magnetic phase transitions occur at $T_{\mathrm{N1}} = 6.7$ and $T_{\mathrm{N2}} = 5.7$ K. A 1/2 quantum magnetization plateau appears between 8 and 30 T at 2 K.
We carried out neutron diffraction experiments at 0 T using the HRPT diffractometer at PSI. The wavelength of the neutrons was 2.450 Å. We observed magnetic reflections at 2.3 and 6.0 K. We can index the magnetic reflections with the propagation vector $(k_x \sim 0.46, 0, 0)$, indicating an incommensurate magnetic structure. We are analyzing the data to determine the magnetic structure.
We conducted neutron diffraction experiments at zero and finite magnetic fields using the WOMBAT diffractometer at ANSTO. The wavelength of the neutrons was 2.412 Å. We observed magnetic reflections at 10 T and 1.9 K where the 1/2 quantum magnetization plateau appears. Indices of the magnetic reflections except for those at $Q = 1.06$ and 1.02 Å^{-1} are integers and nuclear reflections exist at the positions of the magnetic reflections with the integer indices. The magnetic reflections remain at 10 T and 15 K that is much higher than $T_{\mathrm{N1}} = 6.7$ K, indicating that the magnetic reflections are generated by field-induced magnetic moments. The sum of m_1 and m_2 at 10 T and 1.9 K should be 2.2 because of the 1/2 quantum magnetization plateau phase and $g = 2.2$. Here, m_1 and m_2 are magnitudes of field-induced magnetic moments on Ni1 and Ni2 sites, respectively. We calculated the integrated intensities of the magnetic reflections under the condition that $m_1 + m_2 = 2.2$. The calculated and experimental intensities agree with each other in the vicinity of $m_1 = 0.2$.
The magnetic reflections at $Q = 1.06$ and 1.02 Å^{-1} exist below 10 T at 1.9 K, whereas they do not exist at 10 T and 10 K. Therefore, the origin of the magnetic reflections seems to be magnetic order. Although the 1/2 quantum magnetization plateau phase at 10 T and 1.9 K is paramagnetic, the magnetic order phase may coexist.

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