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論文題目 : Study of the Magnetic-Field and Pressure Effects on the Metal-to-Insulator Transition System $BaVS_3$
(金属―絶縁体転移を示す系 $BaVS_3$ の磁場―圧力効果の研究)

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論文要旨:

Vanadium sulfide $BaVS_3$ has a hexagonal perovskite-type structure in which face-sharing VS_6 octahedra compose a spin chain along the c-direction. The metal-to-insulator (MI) transition takes place at T_{MI} ~ 70 K accompanied by the formation of charge density waves. This means that one-dimensional Peierls instability is important in determining physical properties of $BaVS_3$ in contrast to almost isotropic macroscopic properties. Application of pressure or magnetic field is effective to tune the electronic state. A metallic conductivity is recovered above the critical pressure p_{cr} of 2.0 GPa. Under high magnetic field, a metamagnetic transition is observed around 50 T. In spite of enthusiastic experimental works, the magnetic properties of $BaVS_3$ are still unclear even in a high temperature paramagnetic state.

In this study, we shed light on a combination of both pressure and magnetic field as a key to understanding of controversial physical properties of $BaVS_3$, Magnetic susceptibility and magnetization measurements of a powdered sample of $BaVS_3$ have been done under high pressure up to 1.15 GPa and pulsed high magnetic fields up to 50 T. We found that 67% of paramagnetic moment above T_N was involved in a metamagnetic transition which was observed below a critical pressure p_M of 0.90 GPa. In addition, we found an anomaly at T_a ~ 60 K, which is different from the original MI transition. This anomaly has also the same critical pressure p_M. Accordingly, we have revealed that two spin gaps open below T_{MI}. By considering metallic magnetism, we have proposed two models, "c-d hybridization" and "multiple Peierls transition", to interpret the magnetism in $BaVS_3$.