Metal-Insulator Transition in Hollandite Vanadate, $K_2V_8O_{16}$

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Vanadium oxides have attracted considerable interest in the novel properties such as metal-insulator transition [1], charge order transition [1], pressure-induced superconductivity [2] and so on. Some vanadium oxides with the Hollandite-type structure were also reported. Among them, $Bi_xV_8O_{16}$ is famous in its metal-insulator transition [3]. The structure of Hollandite vanadate $A_2V_8O_{16}$ consists of V_8O_{16}-framework and *A*-cation located at the tunnel sites of V_8O_{16}-framework. The V_8O_{16}-framework is constructed from the double chains formed by sharing the edges of VO_6 octahedra. We successfully synthesized $K_2V_8O_{16}$ by a solid state reaction under 4 GPa at 1473 K for 30 minutes. Small crystals were also found in the sintered sample. $K_2V_8O_{16}$ shows a metal-insulator transition with the jump of reisitivity about three orders around 170 K, accompanied by the structure change from tetragonal to orthorhombic and the large reduction of magnetic susceptibility. Electron diffraction study reveals a superlattice of $\sqrt{2} \times \sqrt{2} \times 2$ in the low-temperature insulator phase. Taking these results into consideration, we propose a charge ordered model for the low-temperature insulator phase in which V^{4+}-V^{4+} spin singlet pairs are formed. We also first synthesized $Rb_2V_8O_{16}$ and discovered a metal-insulator transition around at 150 K.

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