Magnetic properties of the kagome staircase mixed system $(Co_xNi_{1-x})_3V_2O_8$

Abstract

The orthooxovanadates of the 3d transition metals $M_3V_2O_8$, known as *kagome staircase* systems, reveal interesting magnetic properties due to their crystal structure. Although these compounds are isostructural for M=Co, Ni, Mn, Cu, they differ considerably with respect to their magnetic phase transitions and magnetic structures. As the magnetic ions are situated on corners of corner-sharing triangles, geometric frustration plays an important role in this system. This is not only confined to the fact, that the antiferromagnetic structures exhibit reduced magnetic moments, but apparently also to the ferromagnetic structure of $Co_3V_2O_8$, which exhibits a strongly reduced Co moment of 1.54 Bohr magnetons.

Within this work precisely this ferromagnetic structure has been investigated in detail and it could be shown that the relatively weak magnetic moment does not result from frustration, but is a consequence of the strong hybridization effects between the cobalt and oxygen orbitals. The pronounced covalent character of this Co ion leads to the fact that due to the charge transfer the oxygen ions significantly contribute to the bulk magnetization when applying an external magnetic field.

The second part of the presented work deals with the systematic investigation of the mixed system $(Co_xNi_{1-x})_3V_2O_8$. A detailed magnetic phase diagram could be drawn, in which the temperature and composition dependent magnetic phase transitions have been pinpointed. Furthermore, an interesting magnetic structure of a chosen composition of x=0.5 has been observed, which differs considerably from those of the end members.