Layered hybrid organic-inorganic Co(II) alkylphosphonates. Synthesis, crystal structure and magnetism of the first two members of the series: [Co(CH₃PO₃)H₂O] and [Co(C₂H₅PO₃)H₂O]

C. Bellitto, E. M. Bauer, M. Colapietro, S. A. Ibrahim,

Abstract:

Co[(CH₃PO₃)(H₂O)] (1) and Co[(C₂H₅PO₃)(H₂O)] (2) were prepared by the hydrothermal method and isolated as blue-violet platelet crystals. They were characterized by X-ray diffraction, FT-IR, TGA-DSC techniques and their magnetic properties studied by a dc-SQUID magnetometer. Compound (1) shows an hybrid layered structure, made of alternating inorganic and organic layers along the a-direction of the unit cell. The inorganic layers contain Co(II) ions six-coordinated by five phosphonate oxygen atoms and one from the water molecule. These layers are separated by bi-layers of methyl groups and van der Waals contacts are established between them. In compound (2), the layered hybrid structure is rather similar to that described for compound (1), but the alternation of the inorganic and organic layers is along the b-direction of the unit cell. The magnetic behavior of (1) and (2) as function of temperature and magnetic field was studied. The compounds obey the Curie-Weiss law at temperatures above 100 K, the Curie C, and Weiss 0 constants for the methyl derivative being C = 3.36 cm³ K mol⁻¹ and 0 = -53 K and for the ethyl derivative C = 3.62 cm³ K mol⁻¹ and 0 = -75 K, respectively. The observed magnetic moments for Co atom at room temperature (i.e. μeff = 5.18 and 5.38 BM, respectively) are higher than those expected for a spin-only value for high spin Co(II) (S = 3/2), revealing a substantial orbital contribution to the magnetic moment. The negative values of 0 are an indication of the presence of antiferromagnetic exchange couplings between the near-neighbors Co(II) ions, within the layers. [Co(CₙH₂ₙ₊₁PO₃)(H₂O)] (n = 1,2) are 2D Ising antiferromagnets at low temperatures.

Keywords:

Organic compounds ; Transition element compounds ; Inorganic compounds ; Orthorhombic lattices ; Antiferromagnetic materials ; Bilayers ; Cobalt complexes ; Phosphonates ; Lamellar structure ; Hybrid material ; Crystal growth from solutions ; Aqueous solutions ; Curie-Weiss law ; Magnetic field effects ; Temperature dependence ; Differential scanning calorimetry ; Thermogravimetry ; Fourier transform spectra ; Infrared spectra ; XRD ; Hydrothermal synthesis ; Crystal structure ; Experimental study

Published In: