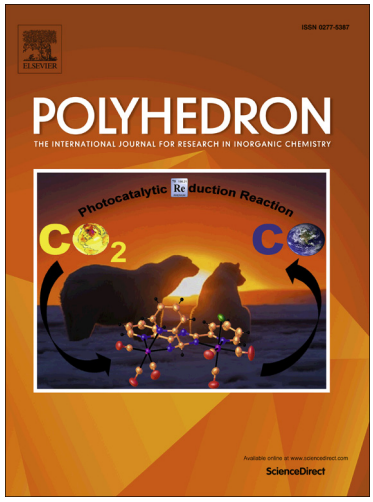

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Manifold Relaxation Processes in a Mononuclear Co(II) Single-Molecule Magnet

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Abstract

Mononuclear Co(II) complex $[Co(Me_6tren)Cl]ClO_4$ has been investigated in terms of the AC susceptibility studies at various frequencies, temperatures, and external magnetic fields. In addition to the slow magnetic relaxation present even in an absence of the external field, the application of the B_{DC} = 0.2, 0.4, and 0.8 T induces a second, slower relaxation path. The effective barrier to spin reversal is little sensitive to the magnetic field and stays approximately U/k_B ~ 20 K. The extrapolated relaxation time for the faster process varies between 3×10^{-9} and 6×10^{-8} s. At T = 2.0 K the detected relaxation time is $(1 - 3)\times10^{-4}$ s for the faster branch and 0.06 – 0.3 s for the slower branch, respectively.

Keywords: Single molecule magnet, slow magnetic relaxation, AC susceptibility, Co(II) complex

1. Introduction

Identification of a slow magnetic relaxation in 3d metal complexes, as a prerequisite of the single-molecule magnetism (SMM) and/or single-ion magnetism (SIM), registers an increasing interest in the last decade. Today, a number of Mn(III), Fe(III), Fe(II), Fe(I), Co(II), Ni(II), and Ni(I) complexes were identified as SMMs (SIMs) [1-29]. In the family of Co(II) complexes showing the SMM behavior the geometry of the chromophore involves heptacoordination, hexacoordination, pentacoordination, tetracoordination, and tricoordination as reviewed recently [30]. Most of them display the field-induced SMM in the presence of a small DC field, typically B_{DC} = 0.1 – 0.2 T. However, a few of them show SMM even in the absence of an external field [9,10]. To this family belong the complexes $[Co(Me_6tren)Cl]ClO_4$ (hereafter **1**) and $[Co(Me_6tren)Br]Br$ where Me_6tren is a tetradentate N-donor ligand, tris[2-(dimethylamino)ethyl]amine [32]. Their properties were investigated by magnetic studies (g = 2.24, D/hc = -6.2 cm^{-1}), high-field EPR (g_z = 2.2, $g_{x,y}$ = 2.15, D/hc = -8.12 cm^{-1}) as well as *ab initio* calculations. To our best knowledge, the AC susceptibility data were not presented so far and this is the scope of the present communication.

2. Experimental

2.1. Preparation of [Co(Me6tren)Cl](ClO4)

Analytical grade (Sigma-Aldrich) chemicals were used without further purification. The complex $[Co(Me_6tren)Cl](ClO_4)$ has been prepared by the published recipe [32]: $CoCl_2\cdot6H_2O$ (0.200 g, 0.84 mmol) was dissolved in EtOH (20 cm^3) at 55°C. Me_6tren (0.214 g, 0.92 mmol) dissolved in EtOH (10 cm^3) was added dropwise with stirring, forming a blue solution that was stirred overnight at room temperature. $NaClO_4\cdot4H_2O$ (0.118 g, 0.84 mmol) was added with stirring inducting precipitation of pale blue $[Co(Me_6tren)Cl](ClO_4)$ (0.237 g, 67%) which was separated by filtration