Colossal magneto-capacitive coupling in multi-ferroic spinel chalcogenides

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The normal cubic spinel systems AB_2X_4 (X=S,Se) exhibit a wide range of exceptional ground state properties depending on the appropriate choice of *A*- and *B*-site ions. In the case of $CdCr_2S_4$ the Cd^{2+}-ions on the *A*-sites are non-magnetic due to completely filled 4*d*-shells. The electronic configuration of the Cr^{3+} ions on the octahedral coordinated *B*-sites is determined by a 3-fold occupation of the low-lying t_{2g}-levels resulting in a total spin of S = 3/2. The magnetic coupling of the *B*-site sublattice leads to a ferromagnetic transition below T_c = 84 K. At the same time the system is not Jahn-Teller active. The absence of an orbital degree of freedom enables the structural degeneracy to be lifted by local dipolar distortions. As a consequence multi-ferroic behavior, namely the coexistence of ferromagnetism and relaxor ferroelectricity can be detected. In addition, the onset of spontaneous magnetization strongly influences the relaxor dynamics which leads to a very pronounced magneto-capacitive effect of up to 500% close to T_c.

[1] J. Hemberger, P. Lunkenheimer, R. Fichtl, H.-A. Krug von Nidda, V. Tsurkan, A. Loidl, Nature **434**, 364 (2005)

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