Magnetodielectric Response in Magnetic Insulators

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The coupling between electrical charge and spin degrees of freedom in magnetic solids gives rise to a various interesting phenomena, notably magnetoresistance (CMR or GMR) and magnetoelectric effect. Here we focus on Cu^{2+} containing 3D perovskite oxides of the types, $MCuO_3$ (M^{4+}= Se, Te). $SeCuO_3$ is a rare ferromagnetic insulator with and its ground state can be tuned to antiferromagnetic by varying the superexchange Cu-O-Cu bond angle through Te substitution. Dielectric constant measurements under applied magnetic field show that $SeCuO_3$ and $Se_{1-x}Te_xCuO_3$ compositions exhibit significant magnetodielectric effect near Curie temperature indicating a coupling between the electric and magnetic degrees of freedom. A model based on the coupling between uniform polarization and the spin-spin correlation function is presented to explain the different behaviors for these isostructural compounds. The observation of significant magnetocapacitance near the transition temperature suggests routes to enhancing the magnetodielectric response for practical applications.