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Multiferroic Polar Metals. SHIMING LEI, Pennsylvania State University, SHALINEE CHIKARA, Los Alamos National Laboratory, DANILO PUGGIONI, Northwestern University, XIANGLIN KE, Michigan State University, Z. Q. MAO, Tulane University, J. M. RONDINELLI, Northwestern University, MARCELO JAIME, JOHN SINGLETON, VIVIEN ZAPF, Los Alamos National Laboratory, VENKATRAMAN GOPALAN, Pennsylvania State University
— Ca3Ru2O7 undergoes a second-order magnetic phase transition to AFM-a (ferromagnetic bilayers antiferromagnetically stack along c-axis with magnetic easy axis along a) at TN = 56 K, followed by a concomitant first-order structural and magnetic phase transition to an AFM-b (antiferromagnetic with magnetic easy axis along b) at TS = 48 K. For T<30 K, a quasi-two-dimensional (2D) metallic state exists due to the survival of small non-nested Fermi pockets. With a proper magnetic field applied along b-axis, an additional phase of canted-AFM is induced. Here we propose a new strategy to tune the polar metal Ca3Ru2O7 into insulating state by chemical doping. In the meantime, the superexchange interaction is significantly weakened to allow the existence of a weak ferromagnetic state. Combined with its robust polar nature, we offer an experimental demonstration of a new multiferroic material. The mechanism is further discussed in the framework of hybrid improper ferroelectricity proposed by Benedek and Fennie. This new strategy proposed here may be utilized as a general approach for new multiferroics starting from a material on the verge of the Mott insulating. Here we will discuss our comprehensive magnetization and magnetostriction, and magnetic field dependent SHG study on this material

Shiming Lei
Pennsylvania State University

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