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Cu_3TeO_6: new linear magnetoelectric material revealed by quasi-static electric polarization measurements

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Abstract

Over the last few decades, strong interest in cuprates resulted in the discovery of a variety of intriguing properties such as high-temperature superconductivity, magnetic insulating state, layered crystal structure and the strong interplay between spins, charge and orbital degrees of freedom [1]. The latter being source of the linear magnetoelectric (ME) coupling, effect defined by the appearance of an electric polarization under the application of a magnetic field, and vice versa [2]. ME materials are attractive for application, including magnetic field sensors, switches and actuators, but also in fundamental understanding concerning opposite requirements for the d-orbital occupancy for ferroelectric and (anti)ferromagnetic order. Here I will present the discovery of new magnetoelectric material, copper tellurium oxide, Cu_3TeO_6 with a unique quasi-static electric polarization technique based on a Sawyer-Tower-type virtual ground setup. With $3d^9$ Cu^{2+} ions, Cu_3TeO_6 displays long-range almost colinear antiferromagnetic order below Neel temperature $T_N \approx 62$ K [3]. Our quasi-static electric polarization measurements indicate that below T_N magnetic-field-induced hysteresis loop opens, with saturation polarization increasing linearly with the magnetic field. Together with magnetic measurements and crystal symmetry, these results are in direct conflict with symmetry requirements concerning the ME effect. Therefore, a plausible scenario for the origin of ME coupling in Cu_3TeO_6 will also be discussed.

[1] S. Dong, H. Xiang, and E. Dagotto, National Science Review 6, 629 (2019).
[2] N. A. Spaldin and R. Ramesh, Nat. Mater. 18, 203 (2019).
[3] M. Herak et al. J. Phys.: Condens. Matter 17, 7667 (2005).