Ordered Aeschynite-type Polar Oxides: A New Family of Multiferroics

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We discovered a new family of magnetoelectric multiferroics, $RFeWO_6$ (R = Dy, Eu, Tb and Y) that crystallize in a polar aeschynite-type structure ($Pna2_1$) with an ordered arrangement of Fe^{3+} and W^{6+} ions. Analysis of magnetization and neutron diffraction data of $DyFeWO_6$ reveal a commensurate non-collinear antiferromagnetic ordering of Fe^{3+} spins ($T_N^{Fe} \sim 18$ K), which induce Dy-spins to order at the same temperature. A sudden change in electric polarization (ΔP) appears in all the compounds at the $T_N^{Fe} = 15$ - 18 K. The electric polarization is sensitive to applied magnetic field and the coupling between different magnetic R-ion and Fe-ion moments suppress the polarization to a different extent. While the measured polarization in polycrystalline $DyFeWO_6$ at 3.5 K is about 3 $\mu C/m^2$, the calculated value of resultant ionic polarization of the form (p_x, 0, p_z) is 75560 $\mu C/m^2$ where p_x comes from magnetic ordering and p_z is associated with the polar structure. These findings open up an avenue to explore further new polar magnets with rare-earth/transition metal ions in the ordered aeschynite-type structure.

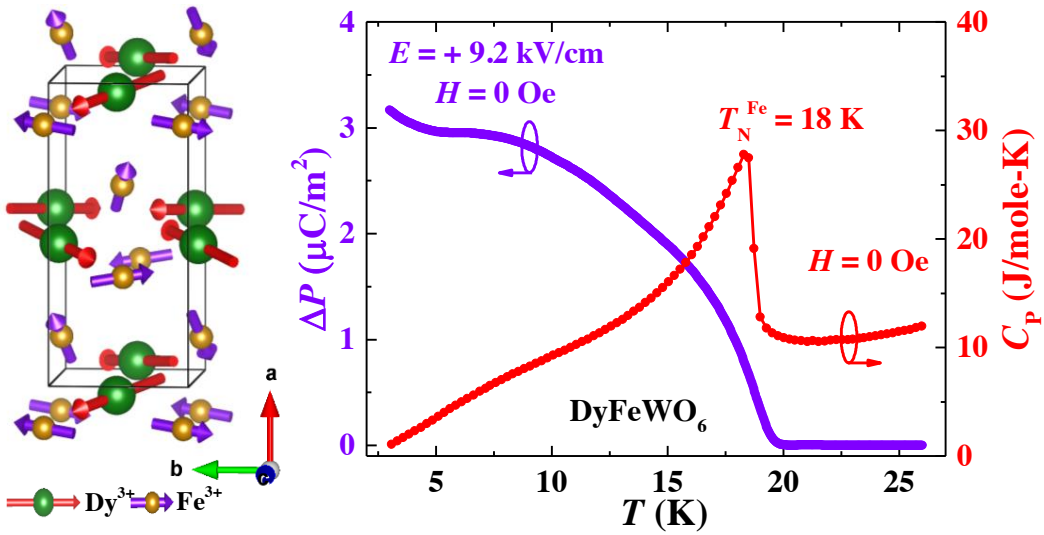

Figure 1: Magnetic structure, magnetic and ferroelectric transition of $DyFeWO_6$

[1]. Somnath Ghara, E. Suard, F. Fauth, T. T. Tran, Shiv Halasyamani, A. Iyo, Juan Rodriguez-Carvajal and A. Sundaresan, Phys. Rev. B, 95, 224416 - 224427 (2017).