MULTIFERROIC BEHAVIOR IN ORGANO-METALLICS

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I will discuss multiferroic behavior in organo-metallic compounds, of which metal-organic frameworks (MOFs) are a sub-class. Organo-metallics are emerging as a new frontier for investigating multiferroic behavior, due to their range of design options, soft lattices and electrically polar organic elements. In addition, we can study interesting physical phenomena due to the coupling of magnetic and electric orders in the quantum regime. In $CuCl_2$-$2SO(CH_3)_2$ we observe a magnetic field-induced multiferroic quantum critical point, with switchable electric polarization with an unusual hysteresis that we probe with ultra-sensitive electric polarization vs. magnetic field measurements in pulsed magnetic fields. The electric polarization closely tracks a non-coplanar spatial-inversion-symmetry-breaking magnetic structure. In another compound $NiCl_2$-$4SC(NH_2)_2$, we observe a magnetic field-induced change in the electric polarization of 50 $\mu C/m^2$ driven by ordering of the Ni $S = 1$ spins. We can model it in terms of a combination of exchange striction and crystal electric fields, and Quantum Monte Carlo simulations of these effects provide an excellent fit to the data. The presence of electrically polar thiourea molecules [$SC(NH_2)_2$] amplifies the effect of small magnetically induced crystal distortions on the electric polarization.