Two Dimensional Crystals of Ferromagnetic $[MnCr(oxalate)_3]^-$ Layer Alternately Stacked with Supramolecular Cations of (2-(*x*-phenyl)ethan-1-aminium)$^+$[18]crown-6 (*x* = H, *o*-fluoro, *m*-fluoro, and *p*-fluoro)

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The magnetoelectric (ME) effect in multiferroics is a prominent cross correlation phenomenon, in which the electric field controls the magnetization, and the magnetic field rules the electric polarization. A strategy for inducing ME effect in hybrid crystals is that enhancing the correlation between two relatively independent units, which rule the electric or magnetic order respectively.[1]

Here we introduced the supramolecular cations of (2-(*x*-phenyl)ethane -1-aminum)$^+$[18]crown- 6 (*x* = H, *o*-fluoro, *m*-fluoro, and *p*-fluoro) as a possible ferroelectric moiety between ferromagnetic honeycomb layer of $[MnCr(oxalate)_3]^-$ to obtained four hybrid crystals **1**-**4**. As shown in Figure **1**, crystals exhibited 2D layered structures, where cations of ((2-phenyl)ethane-1-aminium)$^+$ in **1** and (2-(*o*-fluorophenyl)ethan-1-aminium)$^+$ in **2** partly injected into the layer of $[MnCr(oxalate)_3]$. The presence of fluorine substituents on *m*- and *p*-positions hindered cations intersperse $[MnCr(oxalate)_3]^-$ layer in crystal **3** and **4**, resulting in relatively independent layered structures. The crystal structures, dielectric, and magnetic properties of **1**-**4** will be discussed in detail.

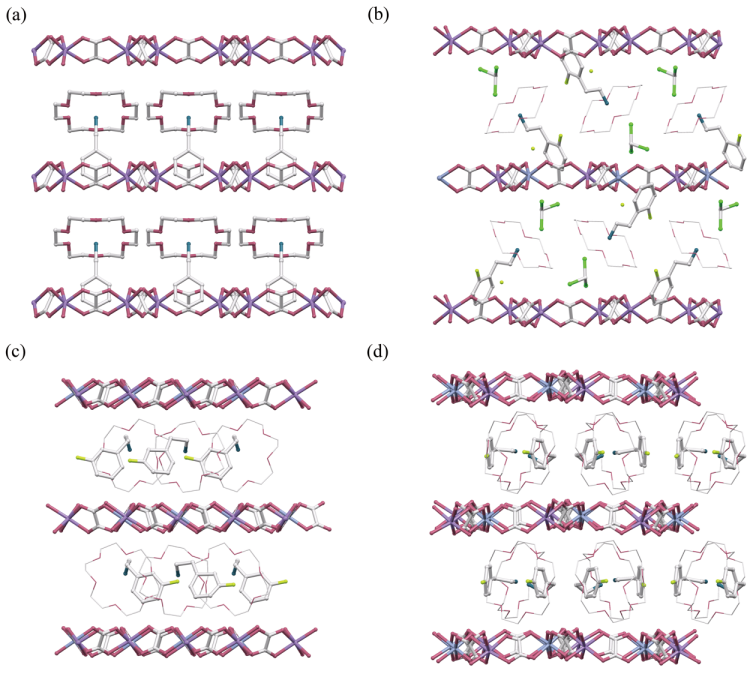

Figure 1. Crystal structures of (a) **1**, (b) **2**, (c) **3**, and (d) **4**

1) Lee J H, Fang L, Vlahos E, et al. *Nature,* **2010**, *466*, 7309.