Poster Presentation

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Exploring ferroelectricity in organic salts or co-crystals

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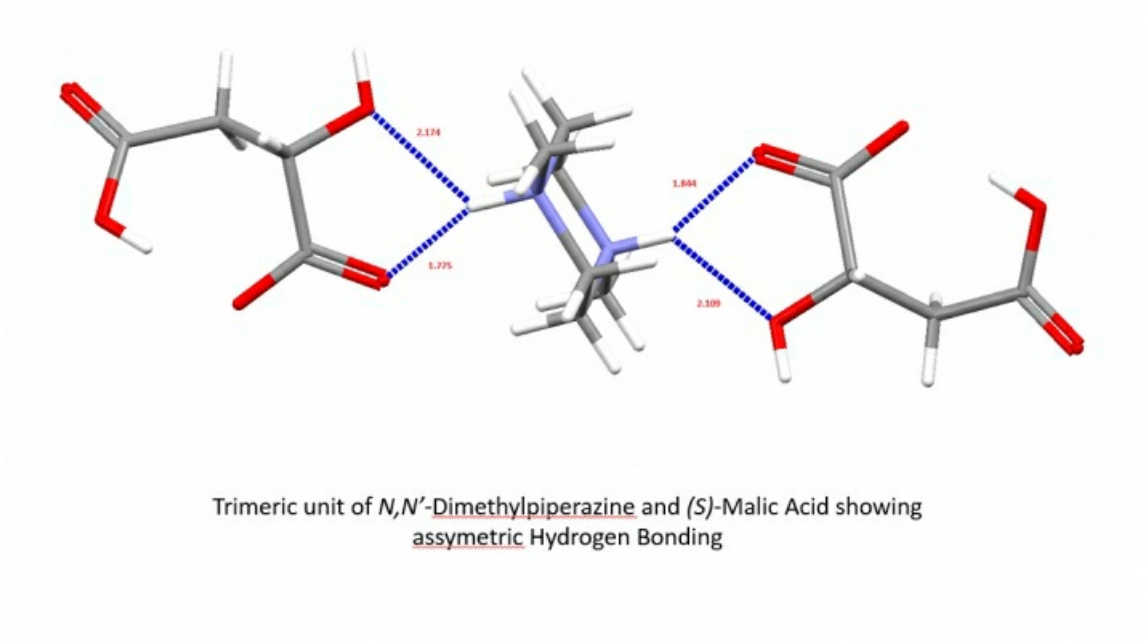
A property that enables switching electric polarization under the influence of an external electric field is known as ferroelectricity. Materials with such properties are called ferroelectric materials, which are electrically polar materials and inhabit spontaneous polarization[1]. Until recently, inorganic ferroelectric materials have been widely used for device applications due to their thermal and mechanical stability. In order to expand applications of ferroelectric materials to electro-optical and electromechanical processes, large interests have been shown to design organic ones over their inorganic counterparts due to their genuine advantages such as lightness, flexibility and most importantly non-toxicity. However, there are only a few examples of organic ferroelectric materials found in the literature[2]. Although ferroelectricity is observed both in single or multi-component organic compounds but the broader design flexibility is achieved in the latter cases. Ferroelectric crystals are known to show order-disorder or displacive characteristics and these are prevalent in multi-component systems; co-crystals or salts. The preferred systems for designing multi-component organic ferroelectrics are (1) electron-donor acceptor compounds – ferroelectricity arises from the collective transfer of electrons or protons and (2) hydrogen bonded binary compounds - ferroelectricity arises from molecular displacements.

Keeping these and other key design elements in mind we have identified few polar co-crystals from CSD and also in the process of synthesizing few more. One of them being 2:1 (S)-malic acids and N,N'-dimethylpiperazine (CSD ref code: MOBYOR) molecule as shown in the figure. This system is shown to have similar structural characteristics as the recently reported pure organic crystal containing 2-chlorobenzoic acid 1,4-diazobicyclo[2.2.2]octane (dabco) in a molar ratio of 2:1, which is stable above room temperature[3]. Our presentation will highlight structural, thermal and physiochemical characterizations and the properties relevant to ferroelectric material.

[1] Lines, M.E. & Glass, A.M. Principles and Application of Ferroelectricity and Related Materials, Oxford University Press, (1977).
[2] Horiuchi et al. Nat. Comm. 8, 14426 (2017) and the references therein.
[3] Yao, et al. J. Am. Chem. Soc. 138, 12005 (2016)



Trimeric unit of *N,N'*-Dimethylpiperazine and *(S)*-Malic Acid showing assymetric Hydrogen Bonding

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