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Towards two-dimensional ferroelectrics and co-crystals

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I will present an experimental study on the self-assembly and electronic properties of the surface-supported hydrogen-bonded organic ferroelectrics, such as croconic acid (CA), rhodizonic acid (RA), 3-hydroxyphenalenone (3-HPLN) and related compounds. Importantly, the polarization of these organics is within the molecular plane, which in principle allows for switchable polarization within 2D molecular sheets. Such 2D sheets of organic ferroelectrics are therefore the focus of this study. I will present an overview over the structural phases of select organic ferroelectrics on various surfaces and demonstrate how ordered 2D polarization states can emerge. I will demonstrate that the co-deposition of CA and 3-HPLN on flat surfaces results in structurally ordered 2D co-crystalline phases wherein various structural isomers and structures of different stoichiometry can be identified. The presented exploratory solvent-free 2D co-crystallization is a departure from existing approaches to co-crystallization, as it could guide the discovery of potentially valuable molecular ferroelectrics, and enable the rational design of organic ferroelectric co-crystals and n-crystals, which quickly become prohibitively complex to investigate using heuristic-guided approaches.