

Advances in Organic 2D Crystals

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Abstract

In contrast to the tremendous efforts dedicated to the exploration of graphene and inorganic 2D crystals such as metal dichalcogenides, boron nitride, black phosphorus, metal oxides, and nitrides, there has been much less development in organic 2D crystalline materials, including the bottom-up organic/polymer synthesis of graphene nanoribbons, 2D metal-organic frameworks, 2D polymers/supramolecular polymers, as well as the supramolecular approach to 2D organic nanostructures. One of the central chemical challenges is to realize a controlled polymerization in two distinct dimensions under thermodynamic/kinetic control in solution and at the surface/interface. In this talk, we will present our recent efforts in bottom-up synthetic approaches towards novel organic 2D crystals with structural control at the atomic/molecular level and beyond. On-water surface synthesis represents a powerful synthetic platform. We will introduce a surfactant-monolayer assisted interfacial synthesis (SMAIS) method that is highly efficient to promote programmable assembly of precursor monomers on the water surface and subsequent 2D polymerization in a controlled manner. 2D conjugated polymers and coordination polymers belong to such materials classes. The unique 2D crystal structures with possible tailoring of conjugated building blocks and conjugation lengths, tunable pore sizes and thicknesses, as well as impressive electronic structures, make them highly promising for a range of applications in electronics, optoelectronics and spintronics. Other physicochemical phenomenon and application potential of organic 2D crystals, such as in membranes, will also be discussed.