Polymer Chemistry in 2D Flatlands

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Abstract
Over the last decade, the discovery of graphene has triggered a new paradigm of two-dimensional (2D) materials. They are featured with a periodic network structure and topographical thickness at the atomic/molecular level, enabling the investigation of fundamental physical and chemical properties down to a single-layer nanosheet. Thereby, robust technologies and industrial applications, ranging from electronics and optoelectronics to energy storage, energy conversion, membrane, sensor, and biomedicine, have been inspired by the discovery and exploration of such new materials.

How can the polymer chemistry contribute to the world of 2D flatlands? In contrast to the tremendous efforts dedicated to exploring graphene and inorganic 2D materials such as metal dichalcogenides, boron nitride, black phosphorus, metal oxides, and nitrides, there remains much less development on organic 2D material systems, 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 realizing a controlled polymerization in two dimensions under thermodynamic/kinetic control in solution and on the surface/interface. This lecture will present our recent efforts on the bottom-up synthetic approaches towards novel crystalline organic 2D crystals with structural control at the atomic/molecular level. We will introduce a surfactant-monolayer assisted interfacial synthesis (SMAIS) method, which is highly efficient to promote precursor monomers' supramolecular assembly 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 structures with possible tailoring of conjugated building blocks and conjugation lengths, adjustable pore sizes and thicknesses, as well as impressive electronic structures, make them highly promising for a number of applications in electronics and spintronics. Other application potential of organic 2D crystals will also be discussed.

REFERENCES

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