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Interfacial Synthesis of Two-Dimensional Polymers

At present, one of the key challenges faced by the scientific community is to go beyond graphene, a prototypical two-dimensional polymer (2DP, a laterally infinite, one atom- or monomer-unit thin, free-standing network with long-range order along two orthogonal directions), to synthesize its analogues with structural control at the atomic- or molecular- level under mild conditions. Here we present the rational synthesis of monolayer and multilayer 2DPs with rigid and symmetric monomers through reversible coordination and dynamic covalent reactions at an air-water interface and liquid-liquid interface. [1-5] Such 2DPs have single crystalline domains with a lateral size in the range of hundreds nm^2 to μm^2. They have a thickness of ~ 0.5 – 10 nm and a lateral size in the range of cm^2 to 4-inch wafer, and can be freely suspended over 20 μm × 20 μm sized holes. They are rigid and flexible, and can be conformed and bonded robustly to nearly any surface, facilitating their integration into devices. Proof-of-concept applications of such 2DPs suggest they are promising materials for energy-related technologies and field-effect transistors.

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