Ultralong-range Two-dimensional End-to-end Networking of Nanorods in Monolayer Thickness

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We describe 2-dimensional network of colloidal CdSe nanorods in monolayer thickness through end-to-end linking, which generates a homogeneous superstructure reaching multimillimeter-scale. End-to-end orientation of nanorods has seldom been reported primarily because van der Waals and dipole-dipole forces preferably induce side-by-side stacking of nanorods. However, in our simple approach, patterns of nanorod assembly, e.g., end-to-end networking vs side-by-side packing can be controlled freely. For end-to-end attraction, we increased capillary forces between neighboring nanorods by capturing them at the air/liquid interface. And then, interfacial deformation, which is the meniscus formed by the captured nanorods, renders nanorods form end-to-end linked network to reduce total interfacial energy. All of the assembled networks are uniformly distributed and highly ordered in large-length-scale without significant 3-dimensional aggregations or coffee-rings, which frequently act as obstacles in the most film devices. This assembly enables the growth of controlled mesoporous films suited for percolating electrical channel. Also, our method will enable diverse materials to be assembled into noble and complex 2-D clusters at large-scale.