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Selective-Assemblies of Frank-Kasper A15 and Other Superlattices via Precisely Controlled Positional Interactions in Nano-Sized Giant Tetrahedra MINGJUN HUANG, CHIH-HAO HSU, JING WANG, KAN YUE, STEPHEN Z.D. CHENG, University of Akron — Diverse self-assembled hierarchical structures in soft materials including small molecules, polymers, and biomacromolecules have been intensely studied. Herein, we report a class of precisely defined, rigid, nano-sized giant tetrahedra molecules, which are constructed by positioning polyhedral oligomeric silsesquioxane (POSS) molecular nanoparticles with different functional groups at the apexes of a tetrahedron framework. Designed symmetry breaking of these giant tetrahedra accurately controlled the positional interactions, leading to diverse selectively assembled, highly ordered superlattices. In particular, a Frank-Kasper A15 superlattice was obtained from a series of giant tetrahedra with three hydrophobic and one hydrophilic POSS cages, which resembled the essential structure of certain metal alloys, but with tunable feature sizes at much larger length scales. Formation of the A15 phase is due primarily to the deformability of the self-assembled spherical building blocks that allows size polydispersity from monodisperse giant tetrahedra.

Mingjun Huang
University of Akron

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