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Giant Molecules based on Precisely Functionalized POSS Nano-atoms: Tuning from Crystals to Frank-Kasper and Quasicrystal Phases STEPHEN Z. CHENG, MINGJUN HUANG, KAN YUE, CHIH-HAO HSU, ZHI-WEI LIN, University of Akron — In order to create new functional materials for advanced technologies, precisely control over functionalities and their hierarchical structures as well as orders is vital for obtaining the desired properties. Among all the giant molecules, giant surfactants and giant polyhedra draw us the special focus. Giant surfactants are constructed via tethering polymers tails to the precisely functionalized polyhedral oligomeric silsesquioxane (POSS) or fullerene (C60) molecular nano-particles (MNPs) (so called "nano-atoms") heads. The heads and tails thus have drastic chemical differences to impart amphiphilicity. Giant polyhedra were created by integrating polyhedron framework with differently functionalized POSS nano-atoms, which further introduce the designed symmetry breaking of positional interactions. A series of novel giant surfactants with multiple polymer tails and giant tetrahedra are utilized as building blocks to construct into hierarchically ordered superlattice structures ranging from crystals, to Frank-Kasper and quasicrystal phases in the condensed bulk state and thin films. This reveals evidently the interconnections between soft matters and hard matters in sharing their common structures and fundamental knowledge.

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