**Giant Polyhedra and Giant Surfactants based on Nano-atoms: Tuning from Frank-Kasper Supramolecular Crystals to Quasicrystals**

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In order to create new functional materials for advanced technologies, both precisely control over functionality and their hierarchical structures and orders are vital for obtaining the desired properties. Among all the giant molecules, giant polyhedra are a class of materials which are utilized via deliberately placing precisely functionalized polyhedral oligomeric silsesquioxane (POSS) and fullerene (C60) molecular nano-particles (MNPs) (so-called “nano-atoms”) at the vertices of a polyhedron. Giant surfactants are polymer tail-tethered “nano-atoms” where the two components have drastic chemical differences to impart amphiphilicity. These giant polyhedra and giant surfactants capture the essential structural features of their small-molecule counterparts in many ways but possess much larger sizes, and therefore, they are recognized as size-amplified versions of those counterparts. One of the most illustrating examples is a series of novel giant tetrahedral and giant surfactants which possessing precisely-defined amphiphilic MNPs with different geometric combinations. With both geometrical and chemical symmetry breakings, these giant tetraphedra and surfactants perform as building blocks to construct when specific interactions are introduced, these polyhedral and surfactants are functioned as building blocks to construct into hierarchical ordered structures. A range of ordered super-lattice structures of this class of materials: crystals, quasicrystals and Frank-Kasper phases have been investigated in the condensed bulk state and thin films, reveals evidently the interconnections between soft matters and hard matters in sharing their common structures and fundamental knowledge.