

Formation of Triply Periodic Hyperbolic Surface Structures via Block Copolymer Self-Assembly

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Gyroid, diamond and primitive surfaces, the most famous naturally occurring triply periodic hyperbolic surfaces, are well known for their amazing properties closely associated with their intriguing symmetries. Basic research into the artificial synthesis and symmetry manipulations of these delicate structures is not only important for the preparation of novel functional materials, but also offers a general understanding of structure formation in soft matter and relevant biological systems.

Herein I will show the synthesis and symmetry manipulation of the hyperbolic surface structures based on the cooperative self-assembly of amphiphilic block copolymer soft template and the inorganic precursors. Particularly, I will discuss (i) A new tetragonal form of gyroid surface, termed Shifted tG, synthesized in a cooperative binary self-assembly system consisting of block copolymer and surfactant. (ii) The bottom-up approach to fabricate the single diamond surface titania networks using the diblock copolymer as a soft template and titania precursor, in which the single diamond scaffold was obtained by kinetically controlled nucleation and growth in the skeletal channels of the diamond minimal surface formed by the polymer matrix. (iii) The structural relationship and interconversion of different types of hyperbolic surface structures.

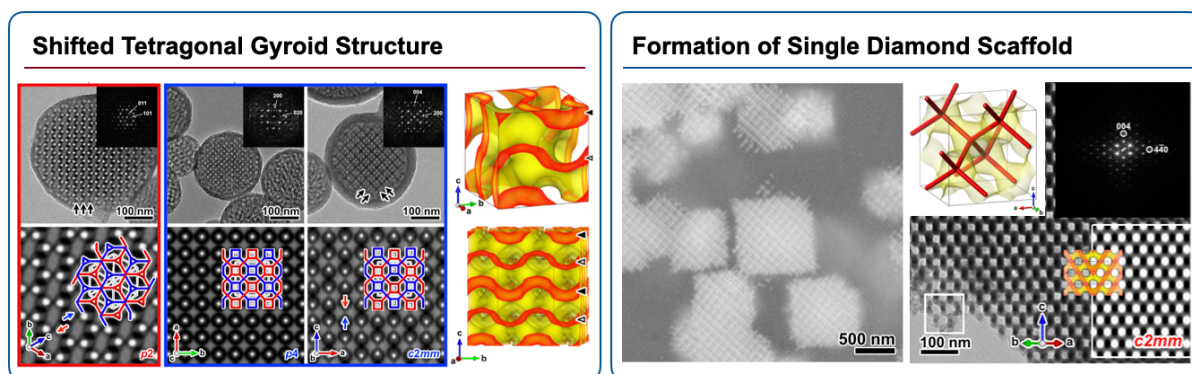


Figure 1 Transmission electron microscopy images and reconstructed 3D volume of the tetragonal gyroid structure, featuring periodic distributions of uneven matrix thicknesses with a low-symmetry space group of $I4_1/a$ (left). The cross-sectional backscattered scanning electron microscopy image, transmission electron microscopy image and the reconstructed 3D structure of the single diamond surface titania scaffold with space group of $Fd-3m$ (right).

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