Truchet-tile structure of a topologically aperiodic metal–organic framework

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When tiles decorated to lower their symmetry are joined together, they can form aperiodic and labyrinthine patterns. Such Truchet tilings offer an efficient mechanism of visual data storage related to that used in barcodes and QR codes. In this contribution, we show that the crystalline metal–organic framework [OZn₄][1,3-benzenedicarboxylate]₃ (TRUMOF-1) is an atomic-scale realization of a complex three-dimensional Truchet tiling [1]. Its crystal structure consists of a periodically-arranged assembly of identical zinc-containing clusters connected uniformly in a well-defined but disordered fashion to give a topologically aperiodic microporous network. Both single-crystal diffuse scattering and 3D-APDF measurements are sensitive to the particular kind of topological aperiodicity present in TRUMOF-1. We suggest that this unusual structure emerges as a consequence of geometric frustration in the chemical building units from which it is assembled.

Figure 1. (Left) Truchet tiling consisting of patterned hexagons and triangles; (right) representative layer of TRUMOF-1 structure showing the coexistence of a periodic arrangement of Zn-containing clusters and aperiodic channels.

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