Reticular chemistry: The design journey from highly-connected building blocks to merged nets

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We will present our recently developed and introduced approaches for the design of intricate multicomponent reticular structures, namely the centring structure-directing agents (c-SDA) strategy and the "merged-net" approach for the design of intricate multicomponent reticular structures. The "merged-net" methodology simplifies the design of complex reticular structures, marking a significant leap in materials science. A systematic process of merging blueprint nets and fundamental structural frameworks in chemical design will be presented. By analyzing 53 edge-transitive nets, we identified unique "signature nets" that facilitate merging distinct frameworks, producing a catalog of 353 new merged-net structures. This expanded catalog offers researchers a more versatile toolkit for constructing complex, multicomponent materials, addressing limitations in traditional materials design.

In addition, progress in MOF Chemistry with built-in information allowing access to highly stabile and made-to-order porous materials, with controlled pore-aperture size and/or inner pore system functionality, toward applications pertaining to energy and environmental sustainability will be presented. Specifically, MOF materials addressing the energy-intensive separations and carbon capture will be highlighted, as well as insights into MOF based membranes, namely pure MOF membranes and mixed matrix membranes (MMMs), construction and respective gas separation properties.