Protein folding and design: from single proteins and their building blocks to nanostructures

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Nanotechnology realizes the advantages of naturally occurring biological macromolecules and their building- block nature for design. Frequently, assembly starts with the choice of a "good" molecule that is synthetically optimized towards the desired shape. By contrast, we propose starting with a pre-specified nanostructure shape, selecting candidate protein building blocks from a library and mapping them onto the shape and, finally, testing the stability of the construct. Such a shape-based, part-assembly strategy is conceptually similar to protein design through the combinatorial assembly of building blocks. If the conformational preferences of the building blocks are retained and their interactions are favorable, the nanostructure will be stable. The richness of the conformations, shapes and chemistries of the protein building blocks suggests a broad range of potential applications; at the same time, it also highlights their complexity.