**Self-assembled nanostructures of multiple block polymers**

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**Abstract**

The self-assembly of colloidal materials is an attractive approach to the formation of 3D nanostructures, which offer electronic, mechanical and magnetic properties necessary for applications such as photonics, energy capture and storage, as well as theranostics (combined therapy and diagnostics). Work in this area has largely focused on the synthesis of various shapes and sizes of monodisperse particles and their assembly through an array of colloidal interactions (*e.g.* electrostatic, van der Waals and DNA hybridisation) (Grzelczak *et al.* 2010; Min *et al.* 2008). However, despite progress towards 'programmability', the self-assembly of colloidal materials remains limited to highly symmetric structures such as small clusters and linear chains (Nie *et al.* 2007; Yan *et al.* 2012). We cannot yet program the self-assembly of colloidal components into arbitrary nanostructures with nearly the same flexibility as provided by 3D printing in the manufacturing of centimetre-scale structures. Such limitation can be attributed to the use of colloidal building blocks that lack the assembly information required to coordinate the spontaneous formation of complex structures.

There remains a fundamental synthetic challenge to achieve the programmable assembly of arbitrary nanostructures, which require both stereospecific and directional control over the selectivity of each independent bond (Cademartiri and Bishop 2015). At present, this level of control is available only for Janus particles, the simplest case of particles with two independent patches of functionality on opposite sides, and significant advances in colloidal synthesis and functionalisation would be required to actualise informed building blocks with more independent bonds.

In this context, we propose colloidal nanoparticles with three or more independent patches by adopting multicomponent reactions (MCRs). PAMAM-type dendritic scaffolds bearing highly abundant functional groups are assembled through isocyanide-based MCRs such as the Passerini 3-component reaction and the Ugi 4-component reaction. We will demonstrate that each independent dendritic scaffold can be functionalised with various pre-synthesised, ‘clickable’ block polymers via Cu-catalysed azide-alkyne (CuAAC) click coupling to induce the self-assembly of complex nanostructures from solution. The proposed approach can be envisioned as an alternative route to the design of polymerisation-induced self-assembled (PISA) nanostructures, which are typically obtained by chain-extending a solvophilic macroinitiator with solvophobic monomers.

**References**

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