**Tunable rheology of physical networks from star block copolymers**

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In recent years, the exploitation of directional interactions has emerged as promising methodology to form reversible self-assembled multi-scale structures, with great significance in technological, energetic and biomedical applications The state-of-the-art to date is the use of DNA constructs to introduce patchy interactions in materials. However, the DNA technology is often complex, and it is desired to combine material responsiveness with simplicity. We present here an alternative strategy to tailor the properties of physical networks through a synergetic use of macromolecular architecture and interactions. Stars with block copolymer arms having alternating block sequences in the same solvent represent the paradigm: telechelic star polymers (TSPs) containing attractive outer blocks self-assemble into soft patchy nanoparticles, whereas the inverted architecture with inner attractive blocks yields micelles. We focus on the concentrated regime where TSPs and micelles form bridged and interpenetrated hexagonally packed nanocylinders, respectively, and examine their structural and rheological properties. We construct phase diagrams and identify different regimes including amorphous liquid, ordered solid and re-entrant liquid, the latter being observed upon both heating and cooling, because of solvent-block and block-block interactions. Of particular interest is the region in the ordered phase characterized by the formation of nanocylinders. The interconnected nanocylinder networks exhibit enhanced storage modulus and extended structural coherence, which at the same time their maximum deformability at break (yield strain) is similar to that of interpenetrated structures, and similar to typical values of a wide range of colloidal depletion gels. On the other hand, they exhibit a much larger yield stress compared to micelles or typical colloidal gels. These results suggest that TSPs are a versatile building block for promising functional materials with tunable rheological properties.

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