Amphiphilic star-like polymers in linear shear flow

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ABSTRACT

Telechelic star polymers (TPSs) are macromolecules formed by a number of amphiphilic diblock copolymers (arms) anchored to a common central core, being the internal monomers solvophilic and the end monomers solvophobic. Very recent studies [1-3] have demonstrated that TPS constitute self-assembling building blocks with specific softness, functionalisation, shape and flexibility: depending on different physical and chemical parameters, e.g. number of arms (functionality), solvophobic-to-solvophilic ratio (amphiphilicity), temperature, and solvent quality. In equilibrium, the geometrical conformation of TSPs features a well defined number of attractive spot on their surface and therefore they can be considered as very tunable soft-patchy colloids, which can lead to the formation of well-controlled ordered and disordered phases in soft condensed matter systems.

We systematically analyse the behaviour of one isolated TSP under linear shear flow by means of a hybrid simulation scheme, which employs Multi-Particle Collision Dynamics (MPCD) for the solvent and standard Molecular Dynamics (MD) for the monomers forming the polymer. We evaluate shape descriptors of the star and distinctive features of the assembled patches per star as a function of the shear rate for a wide range of control parameters. We demonstrate that the shear rate allows to modulate the number and the size of the patches in different ways depending on the amphiphicility and the solvent quality. Since the conformation of a single TSP is expected to be preserved in low-density bulk phases, the presented results are a first step in understanding and predicting the rheological properties of semi-dilute suspensions of this kind of polymers.

REFERENCES

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