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Blends of multi-arm star block copolymer and linear diblock copolymers in a selective solvent

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Since the '60s, polystyrene-polydiene block copolymers are used for a variety of important applications [1], thanks to their propension to display strong microphase separation. Their thermodynamically driven self-assembly allows to build up a network with mechanical properties similar to those of vulcanized systems.
Block copolymers are in fact present in many industrial fields like e.g. rubber-plastic compounding, bitumen modification, and immiscible blend compatibilization. It is also well known that the strength of microphase separation is influenced by copolymer architecture and composition, as well as by the presence of solvents [2,3]. After seminal Leibler's work [4], important progress has been made over the last 4 decades, especially about the thermodynamics of block copolymers, and useful simulation tools are now available [5]. Nevertheless, research in this field is still in progress, e.g. regarding multiarm star block copolymers (i.e. with >15 arms) rheological behavior and how their polymeric blocks phase-separate [6]. An additional problem of practical importance is also the fine tuning of phase separation and the rheological behavior of blends of different kinds of block copolymers (triblock, diblock, multiblock etc), in presence of solvents of varying selectivity.
This work focuses on the microphase separation and rheological response of multiarm SBS (polystyrene-polybutadiene-polystyrene) star block copolymer solutions in a selective solvent, in presence of varying amounts of diblock linear copolymer with same composition. Samples with varying molar mass of the diblock linear copolymer have been investigated. In our samples set, the molar mass of the diblock copolymers takes larger values than the star arm molar mass. With such samples, using rheological characterization we highlighted a stronger micro-phase separation at room temperature after addition of the diblock copolymer as well as lower viscosity at high temperature, above the Order-Disorder Temperature. This opens the route to the overcome of practical tradeoffs in some applications and provides a set of experimental measurements useful to deepen our understanding of micro-phase separation in multiarm star block copolymer systems.

References:

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