DYNAMICS OF MODERATELY ENTANGLED POLYISOPRENE RINGS

R. Pasquino, S. Rogers, F. Snijkers, D. Vlassopoulos

Forth, IESL, Heraklion, Greece

rossana@iesl.forth.gr

One of the outstanding challenges in polymer physics is understanding conformations and dynamics of ring polymers [1]. To meet this challenge, one has to overcome a few difficulties, namely the very low cyclization yield in synthesis and the preparation of completely pure ring polymers. Ring polymers have been indeed shown to be extremely sensitive to presence of linear chains, usually left after synthesis; therefore, critical fractionation is absolutely essential for understanding ring dynamics [2]. Recently, it has been shown that entangled pure ring polystyrenes exhibit self-similar dynamics, yielding a power-law stress relaxation [2, 3]. Moreover, at a concentration almost two decades below their overlapping one, the linear contaminants cause an enhanced mechanical response, and eventually an entanglement plateau is recovered at higher concentrations of linear chains [2].
Here, we extend this work and address a number of open issues. We present results of a large international, interdisciplinary effort in this direction: we use 1,4-polyisoprene rings of molar masses in the range 25-65 kg/mol, prepared in good solvent conditions, hence with absence of knots. We confirm the universality of the linear rheological response, whereas at the same time present nonlinear rheological data (damping functions and stress transients) in comparison to linear polyisoprenes. We also contaminated the PI rings with the linear parents; the enhancement of the mechanical response is discussed as function of concentration of linear parent and molecular weight and compared with the results from PS rings.

Work in collaboration with Y. C. Yeong, Taihyun Chang (Pohang, Korea), Nikos Hadijchristidis, George Sakellariou, Theodore Vasilakopoulos (Athens, Greece), Michael Rubinstein (North Carolina, USA)

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