Cluster Glasses of Semiflexible Ring Polymers

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We present computer simulations of concentrated solutions of unknotted nonconcatenated semiflexible ring polymers. Unlike in their flexible counterparts, shrinking involves a strong energetic penalty, favoring interpenetration and clustering of the rings. We investigate the slow dynamics of the centers-of-mass of the rings in the amorphous cluster phase, consisting of disordered columns of oblate rings penetrated by bundles of prolate ones. Scattering functions reveal a striking decoupling of self- and collective motions. Correlations between centers-of-mass exhibit slow relaxation, as expected for an incipient glass transition, indicating the dynamic arrest of the cluster positions. However, self-correlations decay at much shorter time scales. This feature is a manifestation of the fast, continuous exchange and diffusion of the individual rings over the matrix of clusters. Our results reveal a novel scenario of glass formation in a simple monodisperse system, characterized by self-collective decoupling, soft caging, and mild dynamic heterogeneity.