Abstract Submitted
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Linear and Nonlinear Elasticity of Networks Made of Comb-like Polymers and Bottle-Brushes[1] H. LIANG, A. DOBRYNIN, University of Akron, M. EVERHART, W. DANIEL, M. VATANKHAH-VARNOOSFADERANI, S. SHEIKO, UNC — We study mechanical properties of networks made of combs and bottle-brushes by computer simulations, theoretical calculations and experimental techniques. The networks are prepared by cross-linking backbones of combs or bottle-brushes with linear chains. This results in "hybrid" networks consisting of linear chains and strands of combs or bottle-brushes. In the framework of the phantom network model, the network modulus at small deformations G_0 can be represented as a sum of contributions from linear chains, $G_{0,\mathrm{l}}$, and strands of comb or bottle-brush, $G_{0,\mathrm{bb}}$. If the length of extended backbone between crosslinks, $R_{\max}$, is much longer than the Kuhn length, b_k, the modulus scales with the degree of polymerization of the side chains, n_{sc}, and number of monomers between side chains, n_{g}, as $G_{0,\mathrm{bb}} \propto(\mathrm{n_{sc}}/\mathrm{n_g}+1)^{-1}$. In the limit when b_k becomes of the order of $R_{\max}$, the combs and bottle-brushes can be considered as semiflexible chains, resulting in a network modulus to be $G_{0,\mathrm{bb}} \propto(\mathrm{n_{sc}}/\mathrm{n_g}+1)^{-1}(\mathrm{n_{sc}^{1/2}}/\mathrm{n_g})$. In the nonlinear deformation regime, the strain-hardening behavior is described by the nonlinear network deformation model, which predicts that the true stress is a universal function of the structural modulus, G, first strain invariant, I_1, and deformation ratio, β. The results of the computer simulations and predictions of the theoretical model are in a good agreement with experimental results.

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