Abstract Submitted
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Visco-elasticity of bottlebrush polymer melts: Pushing the lower limit of the entanglement modulus[1] WILLIAM DANIEL, Univ of NC - Chapel Hill, JOANNA BURDYNSKA, Carnegie Mellon University, ANDREY DOBRYNIN, Univ of Conn, KRZYSZTOF MATYJASZEWSKI, Carnegie Mellon University, MICHAEL RUBINSTEIN, SERGEI SHEIKO, Univ of NC - Chapel Hill, MATERIALS INTERDISCIPLINARY RESEARCH TEAM @ UNC CHAPEL HILL TEAM — Without swelling in a solvent, it is challenging to obtain materials with a modulus below *ca.*10^5 Pa, which is dictated by chain entanglements. Here we analyze the densely grafted molecular brush architecture to create solvent-free neat polymer melts and elastomers with plateau moduli down to hundred Pa. Such materials are theorized to behave as linear chains with rescaled dimensions of the entanglement strand due to the increase in both width and persistence length of polymer bottlebrushes. This simple rescaling leads to a prediction that entanglement modulus decreases with the degree of polymerization (DP) of the sidechains to the -1.5 power. Experimental evidence gives a remarkably close power of -1.38 ± 0.05 with moduli in the hundreds of Pascals for long sidechains with DP$\cong$100. The experimental data have been fit using a combination of the Rouse relaxation and double reputation models lending further evidence that bottlebrush polymer behave as linear polymers with large entanglement weights and longer persistence lengths. With the addition of crystallizable block it will be possible to control the crosslinking density and design ultrasoft shapememory materials for use in mechanically sensitive applications.

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