

Abstract Submitted  
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**Distinctive viscoelastic and viscoplastic nanomechanics of ionically cross-linked polyelectrolyte complexes under intermittent relaxation and creep** BIAO HAN, TIANZHU MA, Drexel University School of Biomedical Eng., Sci. and Health Systems, DAEYEON LEE, VIVEK SHENOY, University of Pennsylvania, School of Engineering and Applied Science, LIN HAN, Drexel University School of Biomedical Eng., Sci. and Health Systems — This study aims to reveal unique nanoscale viscoelastic and viscoplastic properties of ionically linked polyelectrolyte networks. Layer-by-layer PAH/PAA complexes were tested by four continuous loading cycles in aqueous solutions. In each cycle, AFM-nanoindentation via a microspherical tip ( $R=5\mu\text{m}$ ) was applied up to  $1\mu\text{N}$  force, followed by a 30-60 sec hold at either a constant indentation depth to measure relaxation, or a constant force to measure creep. At a highly cross-linked, net neutral state (0.01M, pH 5.5), instantaneous modulus increased by 2.7-fold from first to last cycle, while the degree of relaxation ( $>95\%$ ) remain consistent. These results indicate repeated loading increases local cross-link density, while relaxation is consistently dominated by cross-link breaking and re-formation. In contrast, under creep, modulus increased by a similar 3.5-fold, and degree of creep is significantly attenuated from  $\approx 50\%$  to 45% from first to last cycle. Results from creep suggest constant viscous flow of polymer chains in the absence of permanent anchorage. As a result, an irreversible deformation ( $\approx 370\text{nm}$ ) was observed after multiple creep cycles, suggesting the presence of viscoplasticity.

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