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Mechanical properties of supermolecular nanocomposite hydrogels formed by solution assembly of graphene oxide with polyelectrolytes YIPIN DUAN, CHAO WANG, NICOLE ZACHARIA[1], BRYAN VOGT[2], Univ of Akron — In this work, a simple route to generate a family of GO-hydrogels from aqueous solution based assembly of GO without any secondary chemical crosslinking has been demonstrated. Assembly of polycationic poly(ethylenimine), PEI, with GO leads to hydrogels that exhibit the classical signatures of the Payne Effect in filled rubbers, even when the hydrogels contain more than 99 % water. Upon compression, these hydrogels exhibit irreversible stiffening that can increase the storage modulus determined from shear rheology by more than 3 orders of magnitude. This stiffening behavior is generalizable to other anionic 2D materials such as clay nanosheets (cloisite), which suggests that the mechanical properties are driven by jamming of the 2D sheets. The extensional (tensile) properties of these hydrogels can be dramatically improved by the co-assembly with poly(acrylic acid), PAA. At intermediate concentrations of PAA, both the elastic modulus and maximum extensibility are significantly increased to produce a tough nanocomposite hydrogel that is not covalently crosslinked. These studies provide insight into routes to generate tough hydrogels through electrostatic assemblies of 2D materials with polyelectrolytes.

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