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Utilizing Matrix-Filler Interactions in the Design of Stimuli-Responsive, Mechanically-Adaptive Electrospun Composites NANDULA WANASEKARA, DAVID STONE, GARY WNEK, LASHANDA KORLEY, Case Western Reserve University — A new class of all-organic, stimuli-responsive and mechanically-adaptive electrospun nanocomposites, which have the ability to alter their stiffness upon hydration, were developed. These materials were fabricated by incorporating an electrospun mat of poly(vinyl alcohol) (PVA) as the filler in a polymeric matrix consisting of either poly(vinyl acetate) (PVAc) or ethylene oxide-epicholorohydrin copolymer (EO-EPI). The incorporation of high stiffness, high aspect ratio PVA filler mat significantly enhanced the tensile storage modulus of EO-EPI based composites, while modulus enhancement was only noticed above the glass transition for PVAc-based composites. Composite materials based on a rubbery EO-EPI host polymer and PVA filler exhibit an irreversible reduction by a factor of 12 of the tensile modulus upon hydration. In contrast, composites comprised of PVAc show a reversible reduction of modulus by a factor of 280 upon water uptake. The mechanical morphing of the electrospun composites is the result of the filler crystallinity, and matrix-filler interactions facilitated by the surface hydroxyl groups of the PVA filler. The choice of polymer matrix and electrospun nanofiber fillers allow control of matrix-filler interactions in a new series of all-organic composites to achieve desired stimuli-responsiveness and mechanical-adaptability upon exposure to various stimuli.

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