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Molecularly engineered intrinsically healable and stretchable conducting polymers

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Stretchable electronics is a rapidly emerging, multidisciplinary field that envisions a new era of wearable devices. With the vision of mimicking the many functions found in nature, such as stretchability, healing and sense, the next-generation applications including organic electronics, healthcare devices and sensors will require new electronic materials with biomimetic features. The main challenges in developing biomimetic materials for such applications concern large-area fabrication of devices through solution processing and the mechanical compliance of such material with soft biological interfaces. Organic electronic materials, notably conjugated polymers, offer many advantageous properties - the most valuable being versatile synthesis by molecular design, ease of chemical functionalization and solution processability. Herein, we demonstrate that the valuable biomimetic properties and solution processability can be expressed through molecular design and chemical functionalization of conjugated polymers. The simple yet versatile synthetic procedure we present enables one to fine-tune the electrical and mechanical properties without disrupting the electronic properties of the conjugated polymer. The designed material is comprised of a hydrogen-bonding graft copolymer with a conjugated backbone. The morphological changes, which are affected by the composition of functional side chains and the solvent quality of the casting solution play a crucial role in the synthesis of highly stretchable and room-temperature healable conductive electronic materials.

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