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Plastic Deformation as a Means to Achieve Stretchable Polymer Semiconductors

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Developing intrinsically stretchable semiconductors will seamlessly transition traditional devices into a stretchable platform. Polymer semiconductors are inherently soft materials due to the weak van der Waal intermolecular bonding allowing for flexible devices. However, these materials are not typically stretchable and when large strains are applied they either crack or plastically deform. Here, we study the use of repeated plastic deformation as a means of achieving stretchable films. In this talk, critical aspects of polymer semiconductor material selection, morphology and interface properties will be discussed that enable this approach of achieving stretchable films. We show that one can employ high performance donor-acceptor polymer semiconductors that are typically brittle through proper polymer blending to significantly increase ductility to achieve stretchable films. We demonstrate a polymer blend film that can be repeatedly deformed over 65%, while maintaining charge mobility consistently above 0.15 cm2/Vs. During the stretching process we show that the films follow a well-controlled repeated deformation pattern for over 100 stretching cycles.