**Soft Electronic Devices using Flexible, Stretchable and Mendable Polymeric Materials**

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Organic electrochemical transistors (OECTs) are highly attractive for applications ranging from circuit elements, neuromorphic devices to transducers for biological sensing and the archetypal channel material is poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate), PEDOT:PSS. The operation of OECTs involves the doping and de-doping of a conjugated polymer due to ion intercalation under the application of a gate voltage. However, the challenge is the trade-off in morphology for mixed conduction since good electronic charge transport requires a high degree of ordering among PEDOT chains, while efficient ion uptake and volumetric doping necessitates open and loose packing of the polymer chains. Here we demonstrate ionic liquid doped PEDOT:PSS that overcomes this limitation. Ionic liquid doped OECTs show high transconductance, fast transient response and high device stability over 3600 switching cycles. The OECTs are further capable of having good ion-sensitivity. We also look at strategies to achieve polymer films which are robust towards physical deformation and able to self-heal without compromising electronic properties as well as deposition routes for making devices on unconventional curved substrates. Further, we demonstrated a self-powered OECT for point-of-care sensing applications. Our work highlights for the first time, a highly efficient, ambient stable solar cell powered OECT, whose transconductance is nearly unaffected by the incident light intensity due to the balanced electron-hole transport in the solar cell. These findings pave the way for higher performance bioelectronics and flexible/wearable electronics.