Intrinsically Conductive Polymers as Flexible or Stretchable Electrode of Electronic Devices

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Intrinsically conducting polymers were discovered in 1970s. Recent progress in conducting polymers demonstrated their new important application in important areas, such as the next-generation transparent electrode of optoelectronic devices and stretchable electrode of wearable devices. Optoelectronic devices require at least one electrode to be transparent. Indium tin oxide (ITO) is traditionally used as the transparent electrode of optoelectronic devices. But ITO has problems of scarce indium on earth and poor mechanical flexibility. Conducting polymers, carbon nanotubes, graphene and metal wire grids have been proposed to be the transparent electode materials. Among them, poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (Chemical structure shown in Figure 1) is promising to be the next-generation transparent electrode material due to its solution processability, low cost and high transparency in visible range. However, the as-prepared PEDOT:PSS film obtained from PEDOT:PSS aqueous solution usually has conductivity below 1 S cm^{-1}, remarkably lower than ITO. Here, I will present several novel methods to significantly enhance the conductivity of PEDOT:PSS.[1-3] The conductivity can be enhanced to be more than 3000 S cm^{-1}, which is higher than that of ITO on plastic and comparable to ITO on glass. Moreover, PEDOT:PSS have good biocompatibility.

Moreover, PEDOT:PSS can have important application in biomedical engineering as well because of its excellent biocompatibility and high mechanical flexibility. However, it has limited mechanical stretchability due to the rigid conjugated backbone. Here, I will present some of our recent results on improving the stretchability of PEDOT:PSS. We obtained biocompatible PEDOT:PSS with a conductivity of >1000 S/cm and stretchability of >60%.[4-7]

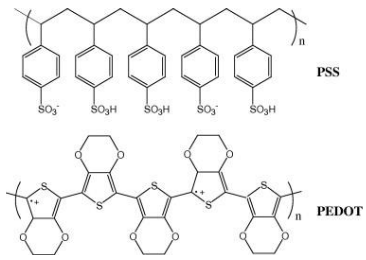

Figure 1. Chemical structure of PEDOT:PSS.

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