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**Correlating Transport with Nanostructure and Chemical Identity in Radical Polymer Conducting Glasses** BRYAN BOUDOURIS, LIZBETH ROSTRO, ADITYA BARADWAJ, MARTHA HAY, Purdue University — Radical polymers are an emerging class of macromolecules that are composed of non-conjugated backbones which bear stable radical groups at the pendant positions. Because of these stable radical sites, these glassy materials are able to conduct charge in the solid state through a series of oxidation-reduction (redox) reactions. Importantly, the redox-active behavior is controlled by both the local chemical environment of the radical polymer groups and by the nanoscale structure of the materials. Here, we demonstrate that proper control of the pendant group chemical functionality allows for the fabrication of transparent and conducting amorphous thin films which have solid-state hole mobility and electrical conductivity values on the same order as those seen in common conjugated, semicrystalline polymer systems [e.g., poly(3-hexylthiophene) (P3HT)]. Furthermore, we show that control of the nanostructure of the materials aids in facilitating transport in these radical polymer thin films. In turn, we implement simultaneous spectroscopic and electrical characterization measurements in order to elucidate the exact mechanism of charge transport in radical polymers. Finally, we demonstrate that, because there is ready control over the molecular properties of these materials, developing bendable and stretchable transparent conducting thin films is relatively straightforward with this unique class of organic electronic materials.

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