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Gueye Magatte. N., Schultheiss Amélie, Mwalukuku Valid M., Carella Alexandre, Simonato Jean-Pierre, et al.. Synthesis and characterization of highly conductive, printable and stretchable PEDOTs: application to thermoelectricity, photovoltaics and thermotherapy. ISFOE23 - 16th International Symposium on Flexible Organic Electronics, Stergios Logothetidis, Jul 2023, Thessalonique, Greece. hal-04813202

**HAL Id: hal-04813202**

**<https://hal.science/hal-04813202v1>**

Submitted on 1 Dec 2024

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## Synthesis and characterization of highly conductive, printable and stretchable PEDOTs: application to thermoelectricity, photovoltaics and thermotherapy

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Conducting polymers have many advantages over inorganic materials, such as low cost, easy deposition through printing techniques and high flexibility. <sup>[1]</sup> However, their electrical conductivity needs improvement to match the requirements of certain applications. Here, we report a straightforward solution-processed approach for the fabrication of poly(3,4-ethylenedioxythiophene) (PEDOT) thin films showing conductivity over 6000 S.cm<sup>-1</sup>. <sup>[2-3]</sup> We will show that such an improvement in PEDOT-based materials' conductivity requires precise control of the water content during the polymerization step. XRD, HRTEM, Synchrotron GIWAXS analyses and conductivity measurements down to 3 K, allowed us to unravel the organization of these highly conductive polymeric materials and their doping and transport mechanisms. We will demonstrate the intrinsic stretchability of thin films made of our PEDOT-based materials and show their remarkably high stability over more than 100 stretching cycles. <sup>[4]</sup> Then we will study the degradation mechanisms of these PEDOT films and highlight the factors that alter their structure, which in turn degrades electrical performance. Finally, we will show that our PEDOT materials exhibit not only high conductivities, but also high transmittance in the visible range, up to 96% at 550 nm. We will then show that our new PEDOT materials can be used to fabricate thermoelectric devices, <sup>[5]</sup> transparent all-polymer heating films, <sup>[6]</sup> and photovoltaic devices.

References: <sup>1</sup>*Prog. Mater. Sci.*, 2020, 100616. <sup>2</sup>*Chem. Mater.*, 2016, 28, 3462-3468. <sup>3</sup>*J. Mater. Chem. C*, 2020, 8, 17254. <sup>4</sup>*ACS Appl. Polym. Mater.* 2021, 3, 11, 5942–5949. <sup>5</sup>*Mater. Chem. Front.*, 2020, 4, 2054. <sup>6</sup>*ACS Appl. Mater. Interfaces*, 2017, 9, 27250-27256.