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Scalable Synthesis of n-PBDF- a solution processable, highly conductive, n-doped conducting polymer

A selenium-catalyzed, scalable route to high-conductivity n-PBDF for printable electronics and sensors.

Researchers at Purdue University have developed cost-effective and scalable methods for the polymerization of n-doped poly(benzodifurandione) (n-PBDF) utilizing new catalysts. Unlike other n-type conducting polymers, which are usually poorly conductive and highly unstable, n-PBDF shows excellent electrical, electronic, optical and electrochemical properties, as well as solution processability and thin film durability. However, existing methods for the synthesis of n-PBDF are hampered by the high cost of oxidative reagents used, slow dialysis processes, or poor scalability of the polymerization when utilizing copper. Purdue researchers have developed a new synthetic method using a cost effective and efficient selenium-based catalyst enabling industrial production of n-PBDF. With their innovative new synthesis methods, these researchers have opened the door for wider use in large-scale production of cost-effective conductive ink. This ink will have applications in printed electronics and beyond, including energy storage, sensors, and bioelectronics.

Technology Validation:

The polymerization reaction shows high conversion (> 99%) of the starting material monomer, verified using 1H and 13C NMR. When measured with the four-point probe method, the polymer was shown to display electrical conductivity above 5000 S cm^-1. In addition, Dynamic Light Scattering measurements were used to characterize the polymer hydrodynamic diameter, and time-dependent ultravioletâ€“visibleâ€“near infrared absorption measurements were conducted to determine reaction time for the polymerization of monomer. Finally, scalability was demonstrated via scale up reactions and spin casting of the n-PBDF as a polymer ink onto a glass substrate.

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Category
Chemicals & Advanced Materials/Specialty & Performance Chemicals
Chemicals & Advanced Materials/Polymer Science & Smart Materials
Computing/Photonic & Optical Computing Technologies

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Advantages:

-n-type conductor

-Low-cost

-High conductivities

-Non-toxic

-High yield

-Easily processable (simple, fast purification)

-Scalable (large area films fabricated)

Applications:

-Optoelectronics

-Printable electronics

-Energy storage

-Sensors

-Bioelectronics

Publications:

"Selenium Dioxide Catalyzed Polymerization of N-doped Poly(benzodifurandione) (n-PBDF) and Its Derivatives." Dr. Guangchao Liu, Hsuan-Hao Hsu, Dr. Sanket Samal, Dr. Won-June Lee, Dr. Zhifan Ke, Dr. Liyan You, Prof. Brett M. Savoie, Prof. Jianguo Mei. Angewandte Chemie, 22 October 2024. https://doi.org/10.1002/anie.202418668.

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