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Additive-Manufactured Electrospun PVdF with Printed Ag Electrodes for Stretchable Pressure & Temperature Sensing

Fully additively manufactured sensor with embedded Ag electrodes that bends, stretches, and scales to large-area or 3D applications.

Pressure and temperature sensors have become an integral part of many industries. However, traditional sensors have generally been limited by their inability to cope with significant bending or stretching. In addition, constructing large sensors is generally an expensive and time-consuming process, relying on the separate manufacturing and assembly of multiple components. This gap in technology has led researchers at Purdue University to develop a new pressure and temperature sensor based on electrospun PVdF fiber with a novel manufacturing process. PVdF is a high-performance thermoplastic with excellent chemical resistance, thermal stability, and physical durability, introducing a new level of flexibility to traditional sensors. With the researchers' novel method, this plastic can be used to produce an ultrafine sensor through an all-additive manufacturing process where the PVdF is electrospun with direct ink writing (DIW) printed Ag ink electrodes embedded within. DIW is an emerging manufacturing method that allows for precise, cost-effective rendering of intricate 3D structures through an all-additive process. The resulting sensor is therefore extremely customizable to any given application. Since the entire sensor is manufactured as one, this method saves on labor and shipping costs, while also cutting down on material waste and time. This sensor is also uniquely capable of bending and stretching with only modest effects on sensing accuracy. Wherever larger sensors are needed, this fabrication method is suitable to creating large, complex 3D sensors quickly and inexpensively relative to comparable methods.

Technology Validation:

Preliminary studies indicate that this device can indeed successfully act as a sensor pressure and temperature sensor. In addition, bending and stretching only very modestly affects its performance.

Technology ID
2023-NAWR-70070

Category
Robotics & Automation/Perception & Sensing
Materials Science & Nanotechnology/Advanced Functional Materials

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Advantages:

-Immensely scalable, suitable for large structures with sensing needs

-Capable of bending and stretching with minimal effects on accuracy

-Faster fabrication time through all-additive manufacturing

-Capable of more complex 3D structures

-Reduces fabrication cost by cutting down on labor and the need to create multiple parts

Applications:

-Large area sensors, such as in construction and large machinery

-Embedded sensor manufacturing with custom shapes and sizes

-Soft robotics

TRL:

Intellectual Property:

Provisional-Patent, 2023-09-18, United States

Utility Patent, 2024-09-18, United States

Keywords: Additive Manufacturing, Direct ink writing, DIW, Electrical Engineering, Mechanical Engineering, pressure sensor, PVdF, sensor, soft robotics, temperature sensor