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# Development of a Sprayable Piezoelectric Material for E-Textile Applications

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**Abstract :** E-textiles are traditional textiles with integrated electronic functionality. It is an emerging innovation with numerous applications in fashion, wearable computing, health and safety monitoring, and the military and medical sectors. The piezoelectric effect is a widespread and versatile transduction mechanism used in sensor and actuator applications. Piezoelectric materials produce electric charge when stressed. Conversely, mechanical deformation occurs when an electric field is applied across the material. Lead Zirconate Titanate (PZT) is a widely used piezoceramic material which has been used to fabricate e-textiles through screen printing, electro spinning and hydrothermal synthesis. This paper explores an alternative fabrication process: Spray coating. Spray coating is a straightforward and cost effective fabrication method applicable on both flat and curved surfaces. It can also be applied selectively by spraying through a stencil which enables the required design to be realised on the substrate. This work developed a sprayable PZT based piezoelectric ink consisting of a binder (Fabink-Binder-01), PZT powder (80 % 2 µm and 20 % 0.8 µm) and acetone as a thinner. The optimised weight ratio of PZT/binder is 10:1. The components were mixed using a SpeedMixer DAC 150. The fabrication processes is as follows: 1) Screen print a UV-curable polyurethane interface layer on the textile to create a smooth textile surface. 2) Spray one layer of a conductive silver polymer ink through a pre-designed stencil and dry at 90 °C for 10 minutes to form the bottom electrode. 3) Spray three layers of the PZT ink through a pre-designed stencil and dry at 90 °C for 10 minutes for each layer to form a total thickness of ~250µm PZT layer. 4) Spray one layer of the silver ink through a pre-designed stencil on top of the PZT layer and dry at 90 °C for 10 minutes to form the top electrode. The domains of the PZT elements were aligned by polarising the material at an elevated temperature under a strong electric field. A d33 of 37 pC/N has been achieved after polarising at 90 °C for 6 minutes with an electric field of 3 MV/m. The application of the piezoelectric textile was demonstrated by fabricating a pressure sensor to switch an LED on/off. Other potential applications on e-textiles include motion sensing, energy harvesting, force sensing and a buzzer.

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