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Hybrid photovoltaic-piezoelectric flexible device for energy harvesting from nature

Statement of the Problem: Photovoltaic materials have unique conversion characteristic that they can convert sun light to electrical energy. However, photovoltaic energy can be expensive if the solar radiation in a particular region is not abundant. When the solar radiation is scarce in a region, there is presence of wind and rainfall. If flexible solar cells are coupled with flexible piezoelectric films then the hybrid structure can generate energy from solar radiation, wind and rainfall. This work focuses on nontransparent hybrid structure which contains copper and aluminum electrodes and eliminates the use of costly indium tin oxide (ITO).

Methodology & Theoretical Orientation: Hybrid film has been developed by depositing organic photovoltaic cell based on P3HT and PCBM on a piezoelectric film under ambient room conditions and tested.

Findings: The hybrid film produced an open circuit voltage (Voc) of 0.45 V and a short circuit current density (Jsc) of 0.43 mA/cm2 under solar simulator and a peak power of 85 μW when subjected to a turbulent wind speed up to 10 m/sec (36 km/hour) in a custom built wind tunnel.

Conclusion & Significance: HPP film has been developed by depositing organic photovoltaic cell based on P3HT: PCBM on a piezoelectric film under the ambient room conditions. HPP film produced was ITO free and cost effective since the usage of expensive clean room procedure has been eliminated. Experimental results proved that the HPP film produced was able to convert both wind energy and solar energy into electrical energy.

Biography

Elias Siores is the Provost and Director of Research and Innovation, Bolton University. He completed his BSc, MSc, MBA and PhD in UK and pursued his academic career in Australia (Sydney, Brisbane and Melbourne) and Asia (Hong Kong, Dong Guan) before returning to Europe (UK) as a Marie Curie Fellow. His R&D work concentrated on advancing the science and technology in the field of "Automated non-destructive testing and evaluation including ultrasound, acoustic emission and microwave thermography. His recent R&D work focuses on Smart/Functional Materials and Systems Development. In this area, he has developed electromagnetic, electrorheological, photovoltaic and piezoelectric smart materials based energy conversion systems for renewable energy, medical, health care and wearable devices. He has published over 300 publications including 8 patents. He has been a member of editorial boards of international journals and a Fellow of IOM, TWI, IEAust, SAE and WTIA. He has received 15 awards in his career for R&D achievements.

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