PVDF/TMDs-AN ADVANCED MATERIAL WITH HIGH PIEZOELECTRIC PERFORMANCE

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Abstract: The emergence of wireless and MEMS technologies (laptop, iPad, mobile, wristwatch, etc.) in modern life has led to a continuous rise in energy usage and ecological issues. These devices are battery-operated, which may have an impact on their functionality like a limited life span and also, it's not eco-friendly. Self-powered gadgets may be the sole answer to these limitations. So, the notion of energy harvesting, which works toward producing self-powered gadgets (that do not require replacing power sources) is a profitable idea. This approach aims to surmount the drawbacks associated with battery-operated portable and wearable. There are several techniques for producing energy. Among these, piezoelectric materials are more beneficial because of their increased charge density and structural flexibility.

Numerous materials exhibit piezoelectricity, encompassing piezoelectric ceramics and piezoelectric polymers. However, all of them have unique benefits and drawbacks. Considering the need for novel, intriguing materials, and addressing the shortcomings of ceramics and polymeric materials in piezoelectric applications, we hereby focus on developing and characterizing the high-performance activation-free piezoelectric polymeric nanocomposite material for its potential application in energy applications. There are a variety of piezoelectric materials, among these materials we targeted a novel nanocomposite material taking Polyvinylidene fluoride (PVDF), a preeminent piezoelectric polymer, and a 2D transition metal dichalcogenide (TMDs) as a semiconducting filler. PVDF and its copolymer (PVDF-TrFE) are currently the only pioneering piezo materials that are acknowledged by the commercial world. But there are certain benefits and drawbacks to these polymeric piezoelectric materials. PVDF exists with five crystalline phases, Among these, the β- phase exhibits potent piezoelectric and electroactive qualities. For use in energy harvesting applications, TMDs are currently considered as unique piezoelectric materials. In the family of transition metal dichalcogenides (TMDs), MoS2, a versatile material, contributes its advantageous qualities due to its wide band gap. Their large band gap, self-poling behaviour, and environmental friendliness are the driving forces behind the selection of this unique material. The present study focuses on the demonstration of the piezoelectric response of the resultant nanocomposite piezoelectric materials which enable for harvesting voltage and current levels of around ≈ 17 V and 1 μA, respectively and are made without the requirement for further pre- or post-activation settings with use of the spin-coating approach. This endeavour has the potential to contribute to the development of sustainable energy solutions for current electronic gadgets.

Keywords: *PVDF-MoS_2, flexible piezo-polymer, poling-free, piezoelectric, energy harvesting*

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