



Flexible piezoelectric nanocomposites developed for biomedical and wearable sensors

Posted On: 21 NOV 2025 12:05PM by PIB Delhi

An innovative piezoelectric device was fabricated using a polymer nanocomposite of flower-shaped tungsten trioxide (WO_3) nanomaterial embedded in a polyvinylidene fluoride (PVDF) matrix, paving a viable path towards flexible, wearable, highly efficient, energy-harvesting, pressure-sensing devices.

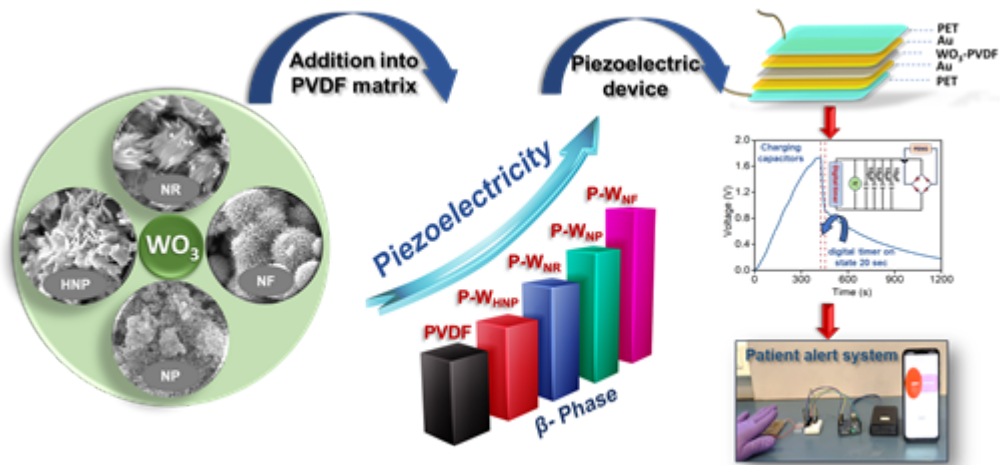
The conversion of mechanical energy to electrical energy is always a topic of great interest since it involves converting day-to-day activities to useful forms of energy and researchers on the lookout for new methods for the same.

Researchers at the Centre for Nano and Soft Matter Sciences (CeNS), Bengaluru, an autonomous institute of the Department of Science and Technology (DST) employed a systematic experimental approach to explore the interactions between polymers and nanomaterials.

They used the same nanofiller to trace their interactions with varying morphologies, crystal structures, and surface charges. Out of the four dissimilar morphologies examined, the nanoflowers characterized by a crystal system with three axes of unequal length and three unequal angles and the highest surface charge (zeta potential: -58.4 mV) demonstrated the most effective interaction with the PVDF matrix, leading to the highest piezoelectric phase. To further enhance energy generation, an optimization process was carried out to determine the ideal nanofiller concentration within the PVDF matrix. This involved the fabrication and testing of self-powered energy-harvesting devices.

The research which involves mixing of flexible piezoelectric polymer and nanoparticles and systematic study of the resultant mechanical energy conversion efficiency gives an insight into understanding/classifying what type of nanoparticle can enhance the piezoelectric properties of a piezoelectric polymer.

This study published in ACS Applied Electronic Materials also demonstrated the possibility of using this prototype for real-time biomedical applications, particularly in patient monitoring.



The figure shows the graphical representation of the research work

The high sensitivity and energy efficiency of this nano-engineered system make it ideal for biomedical uses. In particular, it can be incorporated into wearable health monitoring systems that can capture biomechanical energy from minor to major body movements like heartbeats, pulses, breathing, walking, etc., and transform it into electrical signals. By using these signals, physiological parameters can be monitored in real time without requiring external power sources.

The research by the team Mr. Ankur Verma, Ms. Pritha Dutta, Mr. Nilay Awasthi, Dr. Ashutosh K Singh, Dr. C K Subash is an important step towards intelligent, compact, and sustainable healthcare technologies and opens doors for more widespread uses in energy harvesting and smart textiles. The CeNS team foresees that such cutting-edge nanocomposite-based devices will significantly contribute to the growing demand for next-generation biomedical wearables.

Publication details: DOI: <https://doi.org/10.1021/acsaelm.5c00962>

NKR/AK

(Release ID: 2192413) Visitor Counter : 391

Read this release in: Urdu , हिन्दी , Tamil