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PVDF-HFP-based Piezoelectric Material Incorporated with Inorganic Filler as Polymer Composite Film for Multifunctional Application



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Abstract

The globe is currently dealing with energy and environmental issues. To overcome those problems, we have successfully developed a composite polymer film using the PVDF-HFP co-polymer for e-skin and self-cleaning application. The introduction of PZT@Zn Bi LDH filler achieves an impressive output voltage of up to 12V, higher than pristine which produces ~5V. Furthermore it can degrade organic pollutants such as Congo Red by 87%. Our research concludes that improving each of the properties of the composite materials can produce better composite polymer performance.

Methodology

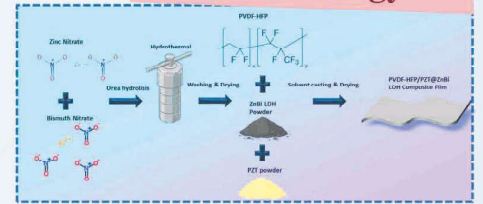


Fig. 1. Schematic diagram representing the process of fabrication of ZnBi LDH and PVDF-HFP/PZT@ZnBi LDH composite film

Results

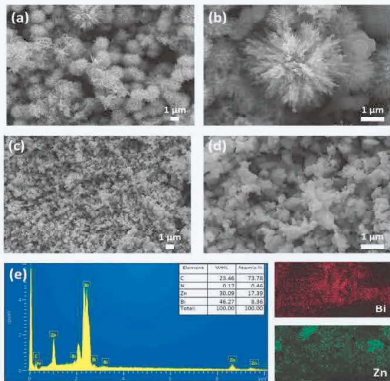


Fig. 2. Morphology of (a-b) ZnBi LDH and (c-d) PZT particles equipped with (e) EDX and element mapping of ZnBi LDH.

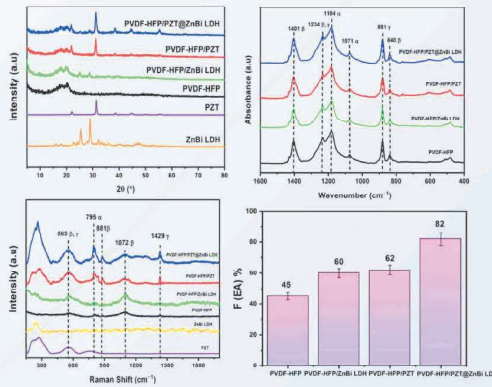


Fig. 3. (a) XRD pattern, (b) FTIR analysis, (c) Raman Spectroscopy, (d) Electroactive β -phase calculation.

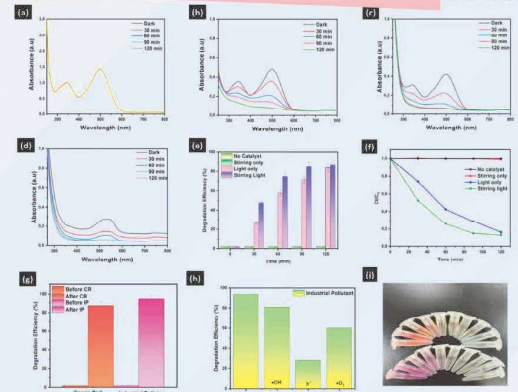


Fig. 4. Piezo-photo response behaviors for degradation of CR&ID by the PVDF-HFP/PZT@ZnBi LDH under different conditions and real sample photograph.

Summary

This study presents a flexible and multifunctional composite made of PVDF-HFP and PZT@ZnBi LDH, which demonstrates photo-piezoelectric responses for e-skin and self-cleaning application. ZnBi LDH enhances the electroactive β phase, improving dielectric and piezoelectric performance, with an output voltage of 12V and a pollutant degradation efficiency of 87%. This material offers a cost-effective solution for developing piezo-photo responsive motion sensors, suitable for use in electronic skin and sustainable technologies.

Acknowledgment

- ❖ Department of Materials Science and Engineering NTUST
- ❖ CTCI Foundation
- ❖ Soft Matter Lab

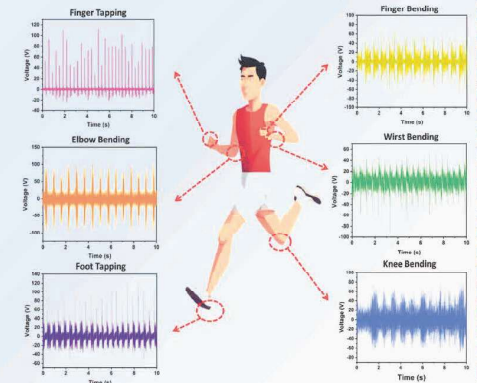


Fig. 5. Diagram illustrating the voltage signals generated when the PVDF-HFP/PZT@ZnBi LDH based e-skin PENGs are applied to various body parts to gather energy.



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