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Biocompatible PVA Blends for High Performance Triboelectric Wearables in Self Powered Cardiovascular Monitoring

Biocompatible PVA-based triboelectric wearables enable self-powered, accurate cardiovascular monitoring and health diagnostics.

Researchers at Purdue University have developed self-powered wearable triboelectric nanogenerators (TENGs) with polyvinyl alcohol (PVA)-based contact layers for monitoring cardiovascular health. Cardiovascular health is typically measured by echocardiogram (ECG) to measure electrical activity in the heart or photoplethysmography (PPG) that measures changes in blood volume in the peripheral microvasculature; however, these technologies can often be invasive to patients and have not yet been adapted into wearables for personalized on-demand monitoring. TENGs with PVA blend contact layers produce fast readout with distinct peaks for blood ejection, blood reflection in the lower body, and blood rejection from the closed aortic valve, which may enable detection of common cardiovascular diseases such as cardiovascular disease, coronary artery disease, and ischemic heart disease. In addition, PVA has some unique advantages over other materials used in TENGS such as starch, chitosan, lignin, or polyamides because it is biocompatible, water-soluble, and costs three to four times less on average. Purdue researchers have characterized optimal compositions of PVA on

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gelatin composite films using proton and carbon NMR to verify molecular structure, dynamic light scattering (DLS) to test coil size reduction and select the best percent by weight of PVA, and finally analyzing dielectric constants of various blends to enhance their energy harvesting capability. In testing with a copper-based band worn on the wrist, these devices show accuracy in measuring the average human pulse as 76 beats per minute. This holistic engineering approach to health monitoring can be implemented for therapeutic and diagnostic applications as well as a myriad of electronics including touch screens, virtual reality, and robotics.

Advantages:

-Reliable

-Accurate

-Wearable

-Self-Powering

-Small

-Mechanically Deformable

-Biocompatible

-Personalized

-On-demand

Potential Applications:

-Biomedical Engineering

-Touch Screens

-HMI

-Robotics

Technology Validation: These TENGs produce a higher dielectric constant than PVA alone and other current TENG materials, and their structure has been verified using proton and carbon NMR as well as DLS to test the coil size of PVA blends to determine an optimal percent by weight of PVA for an ideal PVA-gelatin thin film blend

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