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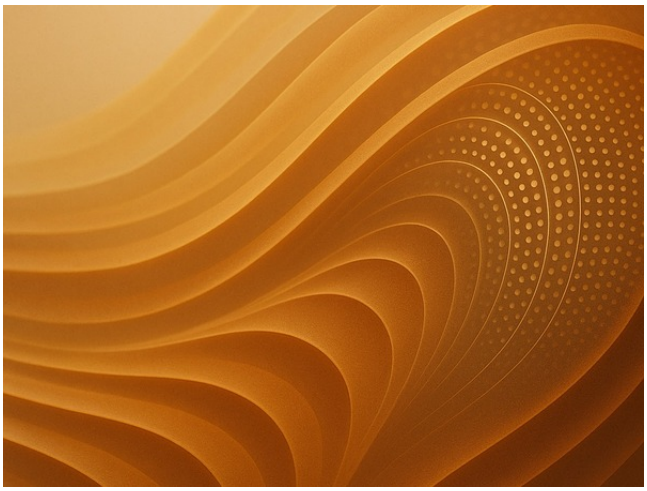
Lignin biomass with dispersion enhanced negative triboelectrification for printed wearables

Printable lignin inks/films enable biobased triboelectric wearables that track cardiovascular/mental workload with ECG-like accuracy and greener materials.



As cardiovascular disease is the leading cause of death in the U.S., there is a need to monitor cardiovascular abnormalities at earlier stages of disease progression to allow for timely intervention and to help advance design strategies for personalized treatments. One factor that negatively impacts cardiovascular disease outcomes is mental workload stress, which increases risk by around 1.5-fold and affects more than 15% of U.S. adults. The current standard of monitoring to assess mental workload is by performing an Electrocardiogram (ECG) test to determine heart rate and variability, but this requires multiple electrodes to be placed at specific positions on the chest, which is limiting for many reasons. Additionally, ECGs are not capable of measuring peripheral circulatory changes, which can obscure certain cardiovascular disease states.

Skin-integrated triboelectric sensors (SITS) have become popular as a newer method for monitoring cardiovascular abnormalities for their tactile perception, motion sensing, and healthcare monitoring abilities. Current

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Category

Chemicals & Advanced Materials/Polymer Science & Smart Materials

Digital Health & Medtech/Wearable Health Tech & Biosensors

Chemicals & Advanced Materials/Materials Processing & Manufacturing Technologies

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SITS are made from synthetic materials, leading to environmental sustainability and biocompatibility concerns, so research has begun to focus on exploring biopolymers as a material for SITS. Lignin has become a good candidate with the correct characteristics for SITS, but synthesis of lignin-based materials requires high temperatures and toxic chemicals for utilization in triboelectric applications. Therefore, there is a need for lignin-based biopolymer compositions and associated methods with less harsh conditions for use in applications such as wearable devices. Researchers at Purdue University have designed lignin-based inks and films as a sustainable alternative to synthetic plastic-based materials for cardiovascular monitoring. This technology establishes a foundation for utilizing lignin and other biomasses in products like wearable devices and health technologies.

Technology Validation:

Lignin-based SITS can determine correlation between mental workload of a person and different conditions via principal component analysis (95% accuracy as compared to ECG)

Advantages

-Lignin is 2nd most abundant biomass on Earth, with a low cost of $300/ton

-Lignin dispersibility in inks and films is 2 orders of magnitude greater than previously achieved

Applications

-Wearable devices and health technologies

TRL: 3

Intellectual Property:

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