Nanomanufactured connected wearable sensors for human body digital twins

Our Mission:
Innovating unprecedented material technologies for next-generation products through nanomanufacturing across length scales.

Core Expertise:
Nanomanufacturing, semiconductor fabrication, data-driven design

Application Areas:
Wearable devices, ubiquitous sensors, robotics, quantum electronics, etc.

Personalized medical digital twins

• Predictive model calibrated using regularly collected historical data aggregated from many devices
• Continuous forecasting and interventions
• Interaction between physical and digital domains

Challenges facing current wearable sweat sensors

• Existing wearables fail to measure critical neurodegenerative disease (ND) specific markers in sweat due to poor sensitivity, selectivity, limit of detection (LoD).
• Widely-adopted multi-omics approaches only portray the average heterogeneous metabolic activities within brain or blood tissue, making it challenging to accurately predict and estimate the specific metabolite variations in sweat.

2D semiconductors for wearable sensors?

• 2D materials exhibit high sensitivity to physiology-relevant signals.
• However, few studies report 2D materials-based sweat sensors, due to the materials' intrinsic limitations that render them poor performance for sweat sensing. Ongoing efforts in 2D semiconductors also face difficulty scaling up due to restrictions on synthesis and stability.

2D semiconductors for wearable sweat sensors

• We demonstrated for the first time wearable sensors that measure DA/NE in real human sweat in real time, leveraging nanomanufacturing of 2D semiconductors.

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Nature Electronics (2018); Nature Nanotech. (2020); Under Review

Submitted; PRF Disclosure 2024-WU-70623

On-body characterization & validation

Al-powered prediction & learning of disease-specific biomarkers

Prediction of metabolic flux and abundance change
Prediction of presence in body fluids
Refinement of sensors

In collaboration with Prof. Chi Zhang at Indiana U. School of Medicine

Opportunities & Prospects for 2D Semiconductor based Wearables

• Imperceptible continuous monitoring of human status

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