

Wearable flexible MoS₂ Photodetectors Enable Monitoring of Microvascular Dynamics in Human Skin

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Metal–organic chemical vapor deposition grown semiconducting transition metal dichalcogenides (TMDCs) have emerged as highly promising materials for next-generation flexible optoelectronic devices due to their exceptional optoelectronic performance, inherent mechanical flexibility, and scalability. These properties enable the integration into lightweight, skin-conformable systems on polymer substrates like polyimide (PI). Continuous, non-invasive monitoring of superficial microcirculation is of great importance for assessing tissue perfusion in vascular diseases and as an early prognostic tool in critically ill patients, yet remains unavailable. Conventional techniques suffer from complex instrumentation, limited portability, or strong observer dependency, while rigid photoplethysmography inherently perturb the signal through pressure-induced flow distortions. In this context, TMDC-based flexible photodetectors offer a compelling alternative by enabling flexible, compact, and robust sensing platforms for non-invasive monitoring of blood microcirculation directly at the skin surface. Here, we present a wearable, patch-based flexible MoS₂ photodetector for targeted non-invasive monitoring of blood microcirculation at the skin surface. Fabricated from monolayer MoS₂ on flexible PI, the device was integrated with green LEDs, enabling sensitivity to microvascular dynamics in superficial skin layers. Performance was evaluated in a vascular occlusion experiment and validated against a commercial laser Doppler interferometer and a pulse oximeter. The observed decrease in photocurrent during occlusion correlates with the increased presence of hemoglobin within the tissue interaction volume and shows excellent agreement with reference measurements, thereby demonstrating the reliability of the flexible MoS₂-based sensing system.

Figures

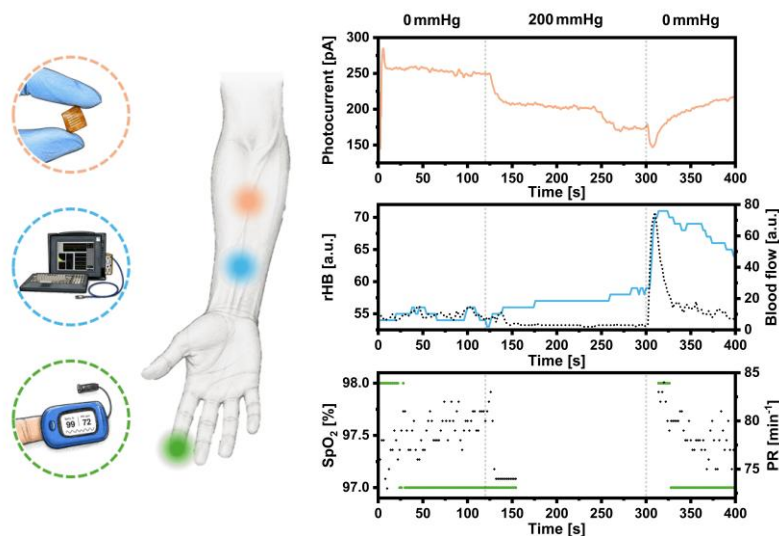


Figure 1: Microcirculation measurements at the skin surface using a MoS₂ photodetector (orange), O₂C device (blue), and pulse oximeter (green)