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Abstract

Multisensing Wearable Technology for Sweat Biomonitoring †

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Abstract: This work describes a multisensing wearable platform for monitoring biomarkers in sweat during the practice of exercise. Five electrochemical sensors for pH, potassium, sodium, chloride, and lactate were implemented in a flexible patch approach, together with a paper microfluidic component, to continuously measure sweat composition. The sensors are fabricated with silicon technologies: ion selective field effect transistors (ISFETs) for pH and ionic species; and a gold thin-film microelectrode for lactate. The latter includes a polymeric membrane based on an electropolymerized polypyrroled structure, where all the biocomponents required for carrying out the lactate analyses are entrapped. The flexible patch is fabricated using hybrid integration technologies, including printed pads defined on a polyimide (Kapton®) substrate and wire bonding encapsulation of silicon chips. To fix and align the sensors to the flexible substrate, different laminated materials, such as polymethyl methacrylate (PMMA), polydimethylsiloxane (PDMS), and silicone-based adhesive, were used. The first results show good performance of the sensors—ISFETS sensitivity between 54–59 mV dec^{-1} for ion ranges in sweat from 2 to 100 mM and lactate sensor sensitivity of -135×102 µA M^{-1} cm^{-2} for the range of 2–50 mM. The microfluidic platform has been tested in terms of adequate sensor wettability and rapid response during the time span of exercise activity (2 h) showing excellent results.

Keywords: wearables; sweat; biomarkers; multisensors; paper microfluidics

Supplementary Materials: The presentation file is available at https://www.mdpi.com/article/10.3390/I3S2021Dresden-10113/s1.

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