

Paper-Like and Battery Free Sensor Patches for Wound Monitoring

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Abstract : Wound healing is a dynamic process with multiple phases. Rapid profiling and quantitative characterization of inflammation and infection remain challenging. We have developed paper-like battery-free multiplexed sensors for holistic wound assessment via quantitative detection of multiple inflammation and infection markers. In one of the designs, the sensor patch consists of a wax-printed paper panel with five colorimetric sensor channels arranged in a pattern resembling a five-petaled flower (denoted as a 'Petal' sensor). The five sensors are for temperature, pH, trimethylamine, uric acid, and moisture. The sensor patch is sandwiched between a top transparent silicone layer and a bottom adhesive wound contact layer. In the second design, a palm-like-shaped paper strip is fabricated by a paper-cutter printer (denoted as 'Palm' sensor). This sensor strip carries five sensor regions connected by a stem sampling entrance that enables rapid colorimetric detection of multiple bacteria metabolites (aldehyde, lactate, moisture, trimethylamine, tryptophan) from wound exudate. For both the 'Petal' and 'Palm' sensors, color images can be captured by a mobile phone. According to the color changes, one can quantify the concentration of the biomarkers and then determine wound healing status and identify/quantify bacterial species in infected wounds. The 'Petal' and 'Palm' sensors are validated with in-situ animal and ex-situ skin wound models, respectively. These sensors have the potential for integration with wound dressing to allow early warning of adverse events without frequent removal of the plasters. Such in-situ and early detection of non-healing condition can trigger immediate clinical intervention to facilitate wound care management.

Keywords : wound infection, colorimetric sensor, paper fluidic sensor, wound care

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