

Fluorescent Ph-Sensing Bandage for Point-of-Care Wound Diagnostics

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Abstract : Diabetic foot ulcers (DFUs) are a serious and prevalent complication of diabetes. Current diagnostic options are limited to macroscopic wound analysis such as wound size, depth, and infection. Molecular diagnostics promise to improve DFU diagnosis, staging, and assessment of treatment response. Here, we developed a rapid and easy-to-use fluorescent pH-sensing bandage for wound diagnostics. In a fluorescent dye screen, we identified pyranine as the lead compound due to its suitable pH-sensing properties in the clinically relevant pH range of 6 to 9. To minimize the release of this dye into the wound bed, we screened a library of ionic microparticles and found a strong adhesion of the anionic dye to a cationic polymeric microparticle. These dye-loaded microparticles showed a strong fluorescence response in the clinically relevant pH range of 6 to 9 and a dye release below 1% after one day in biological media. The dye-loaded microparticles were subsequently encapsulated in a calcium alginate hydrogel to minimize the interaction of the microparticles with the wound tissue. This pH-sensing diagnostic wound dressing was tested on full-thickness dorsal wounds of mice, and a linear fluorescence response ($R^2 = 0.9909$) to clinically relevant pH values was observed. These findings encourage further development of this pH-sensing system for molecular diagnostics in DFUs.

Keywords : wound ph, fluorescence, diagnostics, diabetic foot ulcer, wound healing, chronic wounds, diabetes

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