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FlusiTex RTD 2013

FNSNF

Wound pad as a biosensor to monitor wound healing

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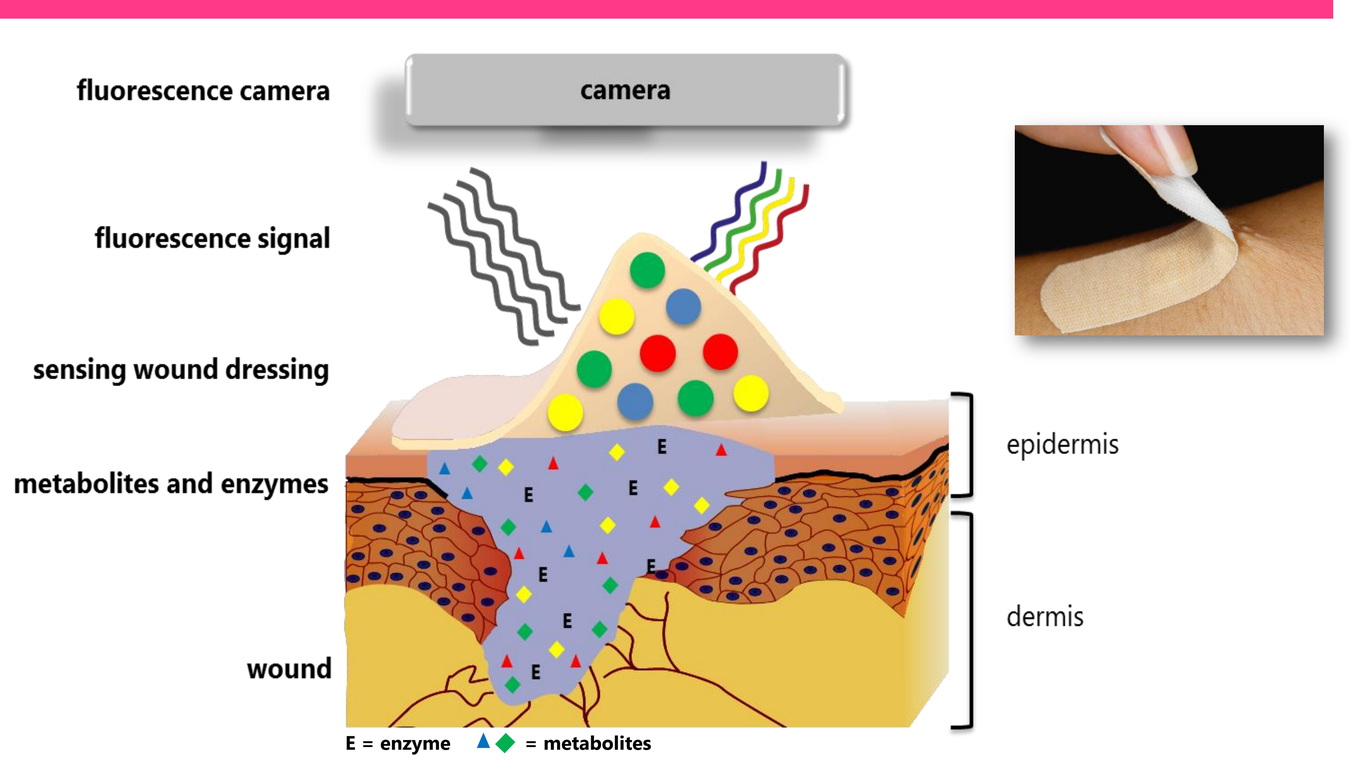
Introduction

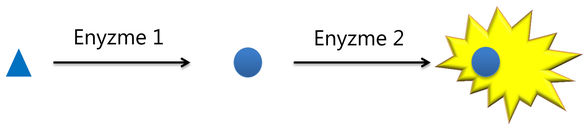
Wound healing is a complex and dynamic process of replacing damaged cells after injury. Disturbances in the process can lead to a **non-healing chronic wound**, which **requires constant monitoring**. Frequent removing of the wound pad may however damage the newly grown tissue cells and increases the risk of infection.

To avoid this, a novel **non-invasive** sensing system was designed, which comprises a textile wound dressing and an integrated **biosensor for continuous monitoring** of the healing phase. The sensor elements detect changes in the metabolite or enzyme concentration and transform them into an optical signal that is measurable with a fluorescence lifetime camera**.**

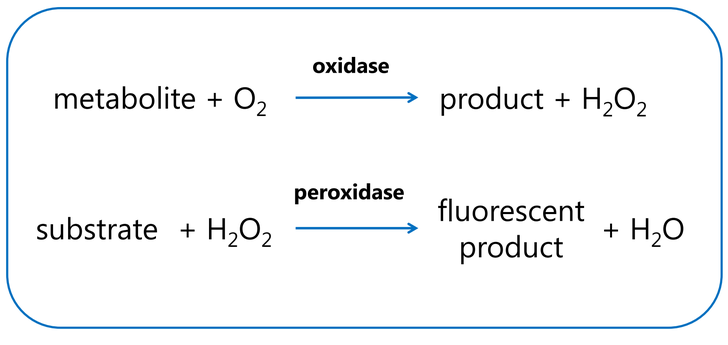


Metabolite sensing

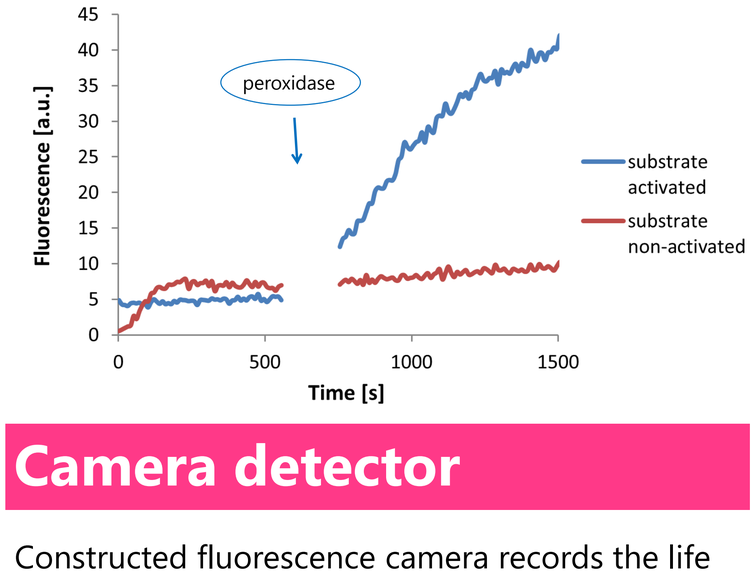
Enzyme selected for coupled assay converts a non-fluorescent substrate into a fluorescent product.



Example

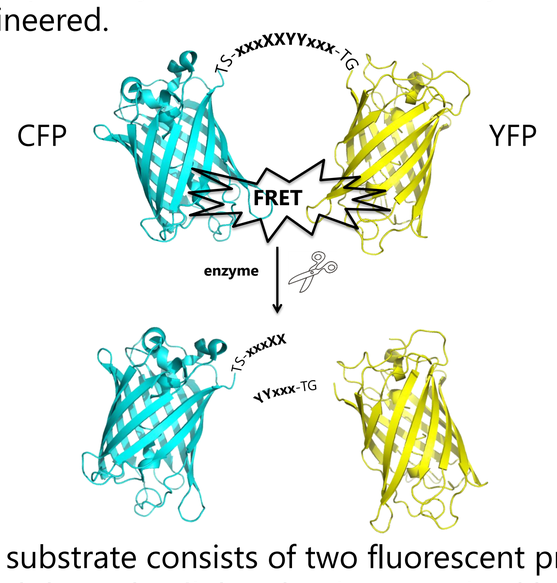


Fluorescence signal increases when enzyme is added to the activated fluorescent substrate.



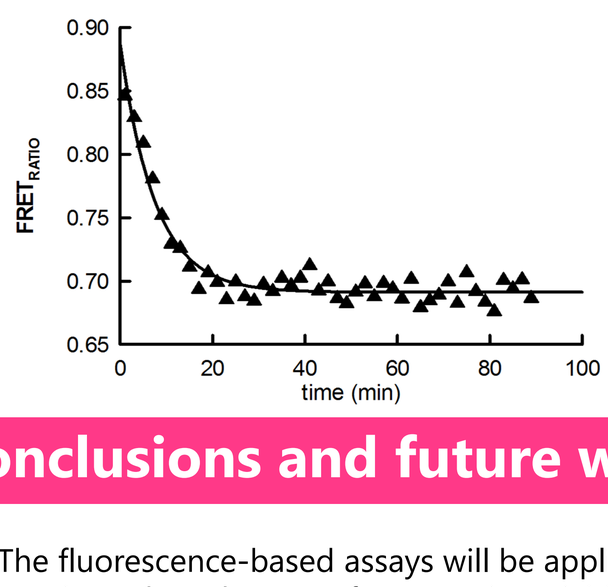
Enzyme sensing

A FRET-based fluorescent substrate that has a high specificity for a wound intern enzyme was engineered.



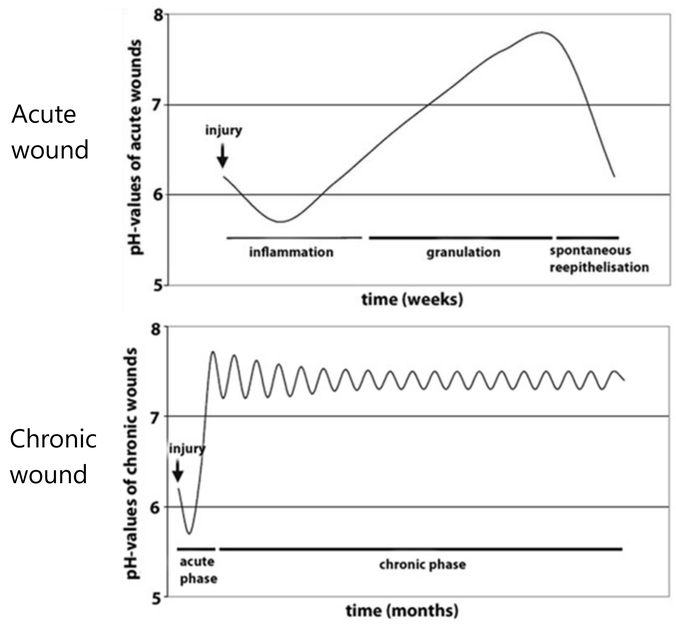
This substrate consists of two fluorescent proteins linked through a linker that is recognized by the enzyme.

Upon clevage, two proteins dissociate and FRET ratio decreases.

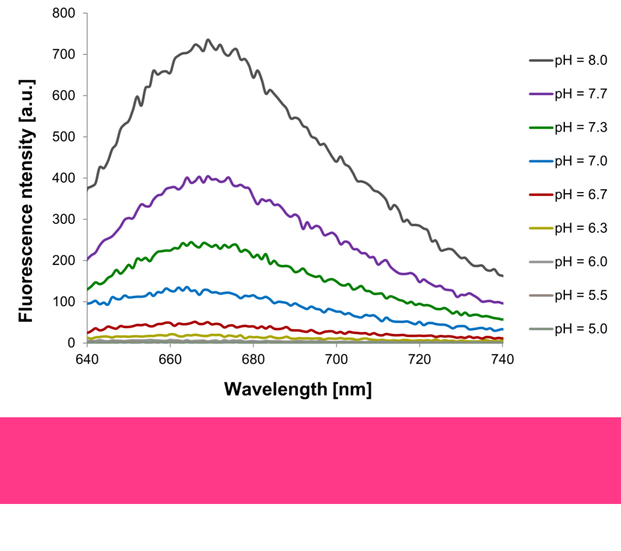


pH sensing

pH of the wound depends on the type of the wound and changes during healing.

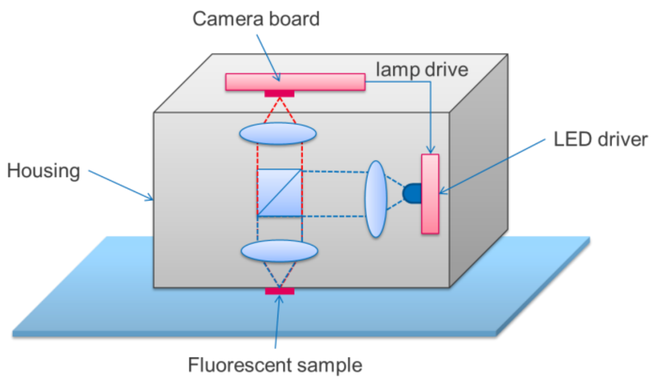


We use a fluorescent dye that respons to the pH change of the artificial wound exudate.



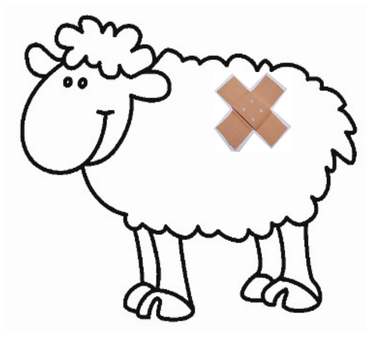
Camera detector

Constructed fluorescence camera records the life time of detected fluorescence.



Conclusions and future work

- The fluorescence-based assays will be applied to monitor a broad range of enzymatic activities
- The enzymes and fluorescent substrate will be immobilized and the system stability and sensitivity studied
- Biosensors for detection of further wound metabolites are under development
- The sensor will be integrated into a wound pad and tested *in vivo*



Publications in preparation

Schulenburg *et al.* „Fluorescent protein sensor for wound enzymes detection."
Schulenburg *et al.* „Simultaneous detection of pH fluctuations and metabolites for wound monitoring applications."