Plastic Optical Fibre Sensor for Humidity Measurements on Wounds

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1. Introduction

- Moisture in wounds accelerates wound healing[1].
  - However, an optimum level of moisture is required.
- Current techniques for monitoring wounds, such as removing the dressing to observe wound evolution, disrupt its healing.
- **Objective**: To develop an humidity sensor to monitor the wound state without removing the dressing.
- The fabrication and sensitivity of a Plastic Optical Fibre Humidity Sensor (POFHS) is presented.

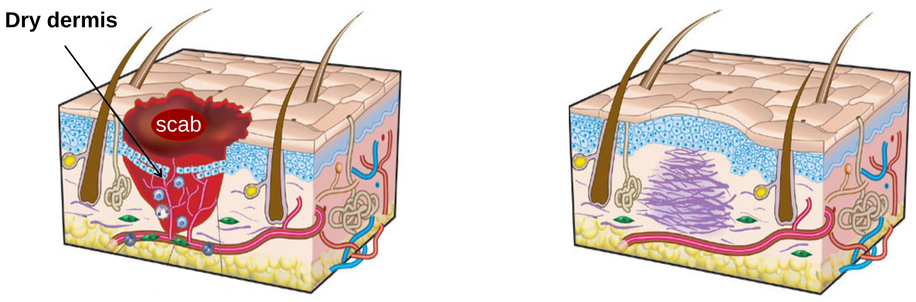

Fig. 1. Wound left uncovered to dry out (left) and wound kept moist by covering (right)

2. Method and experiments

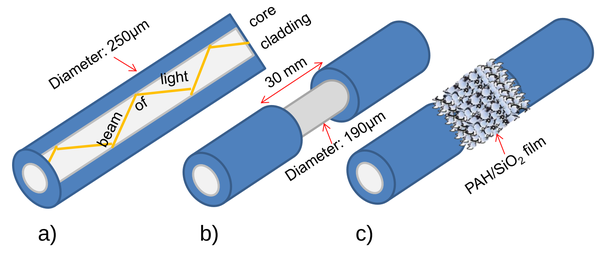

Fig. 2. Fabrication of POFHS

2.1 Fabrication of POFHS

a) Plastic optical fibre

b) Removal of cladding to deposit sensitive film

c) Deposition of 7 layers of hydrophilic film using layer-by-layer method[2,3].

2.2 Skin test set up

1) Halogen Light Source

2) POFHS and commercial sensor

3) Spectrometer to monitor light intensity

4) Spectra Suite Software for monitoring POFHS measurements

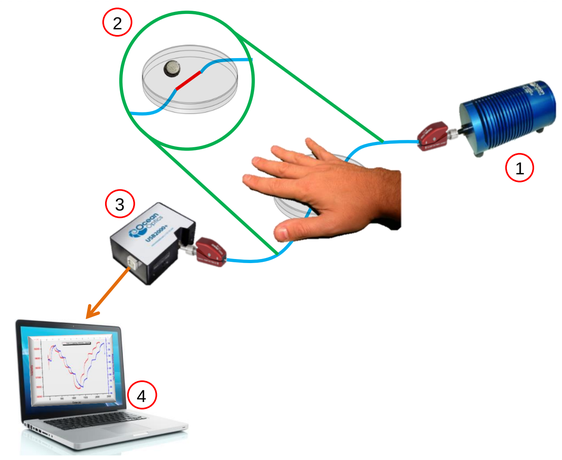

Fig. 3. Experimental set up for humidity sensing on skin.

3. Results

3.1 Fabrication

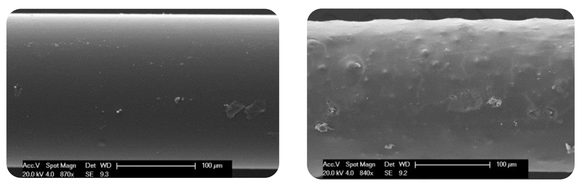

Fig. 4. SEM images of plastic optical fibre before (left) and after (right) film deposition

- Intensity of light transmitted increases with increasing number of layers (Fig. 5).

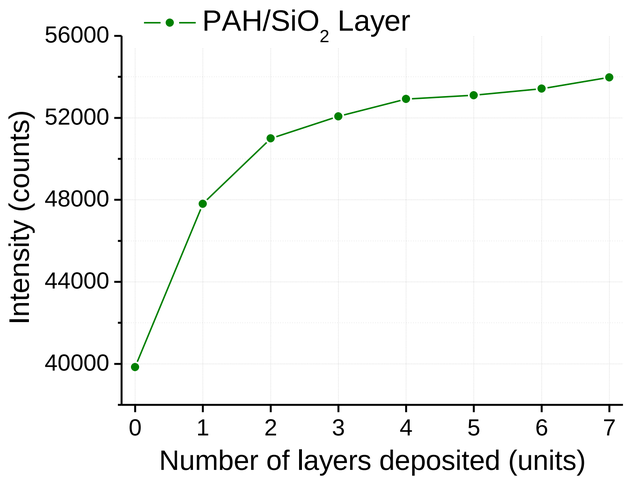

Fig. 5. Intensity of light vs number of layers deposited

3.2 Skin test

- Note: Decrease in light intensity occurs as relative humidity increases.
- The POFHS responds more rapidly to changes in skin humidity (Fig. 6a) than commercial sensor.
- By breathing on the chamber humidity increases hence light intensity reduces.
- Response time of POFHS is 1.1s and its recovery time is 2.6s. Much faster than commercial sensor (7.2s and 9.5s, respectively) (Fig. 6b).

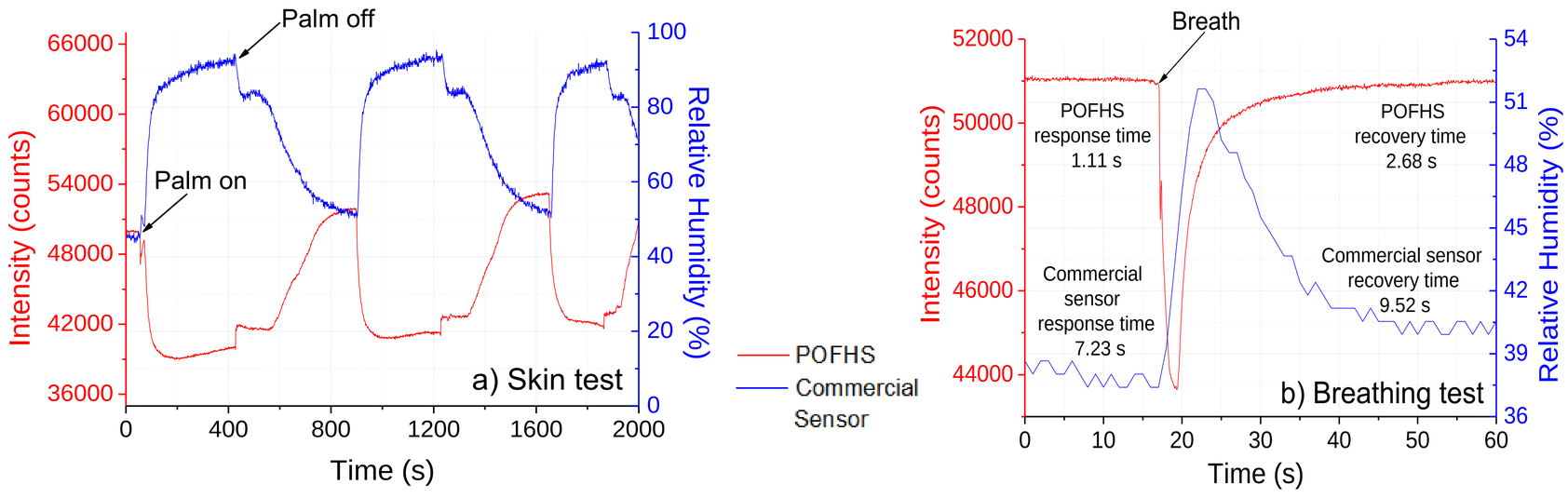

Fig. 6. Humidity sensing with POFHS compared with commercial sensor. (a) Skin test, measurements of humidity on palm. (b) Response over rapid changes of humidity when breathing on the set up.

4. Discussion & Conclusions

- POFHS represents low-cost and reliable approach to obtain humidity measurements.
  - Can be used in wound dressings to monitor wound status without removing dressings thereby reducing health care costs (Fig. 7).
- Enables detection of moisture levels on wounds faster than commercial sensors to provide improved treatment and reduce healing time.

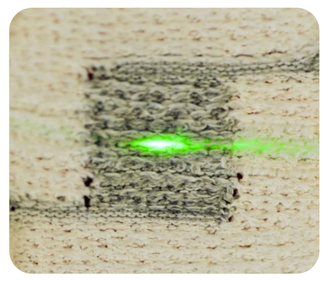

Fig. 7. Potential application of POFS within textiles

Acknowledgements

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Footfalls & Heartbeats

References: 1) G. D. Winter, *Nature,* vol. 193, pp. 293-294, 1962.
2) S. Korposh, T. Wang, S. James, R. Tatam and S.-W. Lee, *Elsevier Sensors and Actuators,* vol. 173, pp. 300-309, 2012.
3) D. Viegas, J. Goicoechea, J. L. Santos, F. Moita Araujo, L. A. Ferreira, F. J. Arregui and I. R. Matias, *Sensors,* vol. 9, pp. 519 - 527, 2009.

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