Microdiamond-Silk Wound Dressings for Early Infection Intervention through Temperature Sensing

Ethan JG Ellul[a], A.Khalid[a], J.P. Tetienne[a], I.O. Robertson[a], G.J. Abrahams[a], L. Hung[a] , A.N. Abraham[a], S. Houshyar[b], T. Ohshima[c], H. Abe[c], H. Haidari[d], Z. Kopecki[d], A. J. Cowin[d], B. C. Gibson[a]

[a]*ARC Centre of Excellence for Nanoscale Biophotonics, RMIT University, Melbourne, Victoria 3000, Australia*

[b]*School of Engineering, RMIT University, Melbourne, Victoria 3000, Australia*

[c]*National Institute for Quantum and Radiological Science and Technology (QST), Takasaki, Japan*

[d] *UniSA Clinical & Health Sciences, University of South Australia, Adelaide, SA 5000, Australia*

The wound healing process for acute injuries, including severe burns and lacerations, involve the painful removal of dressings to ensure surface infection is not present. Without early intervention, infection can spread and lead to further complications such as increased time of healing, skin regrafting, or sepsis. As a clinically diagnosed wound infection may present a temperature increase of up to 5°C compared to healthy skin [1], detection of wound temperature variations may provide an indicator of infection, and so a smart wound dressing is being developed that utilises fluorescent diamond temperature sensors implanted within silk films for early detection of infection.

Micron-sized diamonds containing ensembles of negatively charged nitrogen vacancy (NV^-) centres have been implanted within transparent silk-glycerol films to form a biocompatible and transparent dressing that acts as a detection method for temperature variation without impacting the recovery process.

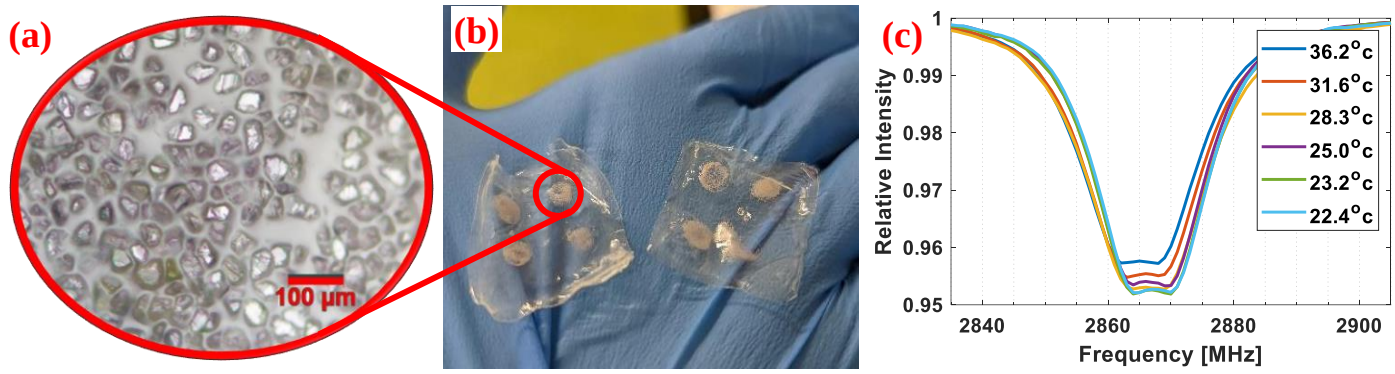

Figure 1 Example smart wound dressing (1b), featuring a transparent silk-glycerol film implanted with temperature sensitive microdiamonds, with 1a showing image of implanted diamonds. 1c shows temperature dependency of ODMR response for temperature monitoring purposes.

Results will be discussed that demonstrates detection of temperature to a sub-degree resolution through use of optically detected magnetic resonance (ODMR). Additionally, results of testing the smart dressing in an artificial wound solution will be discussed to explore its robustness and temperature sensitivity in a simulated wound environment prior to *in-vitro* testing.

1. Chanmugam, A., et al., *Relative Temperature Maximum in Wound Infection and Inflammation as Compared with a Control Subject Using Long-Wave Infrared Thermography.* Advances in Skin & Wound Care, 2017. **30**(9): p. 406-414.

Acknowledgments to the National Health and Medical Research Council Ideas Grant (APP2002254) & RMIT University for providing Ethan JG Ellul with a Master's Scholarship