UNIVERSITY OF SOUTHERN QUEENSLAND

Development and Characterisation of a Chemical Film Actinometer with a Large Dynamic Range for Measurements of Solar Ultraviolet Exposure

A Dissertation Submitted by

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Declaration

The research contained in this dissertation is the full documentation of the research results that were published as

Lester, RA, Parisi, AV, Kimlin, MG, & Sabburg, J. 2003, 'Optical properties of poly(2,6-dimethyl-1,4-phenylene oxide) film and its potential for a long-term solar ultraviolet dosimeter', *Physics in Medicine and Biology*, vol. 48, pp. 3685-98.

I declare that this dissertation is comprised entirely of my own research (except where due acknowledgement is made), and no part of this dissertation has been written by another person. To the best of my knowledge, the work presented here is original and has not been published elsewhere other than in the reference stated above. This dissertation contains no material that to any substantial extent resembles work previously submitted for any other award at the University of Southern Queensland or any other educational or academic institution. All contributions to this dissertation and the research within are explicitly acknowledged.

Rick Lester

Signed .....

06/04/09

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Abstract

Solar ultraviolet (UV) radiation arriving at the Earth's surface is a biological requirement for most forms of life, but also causes adverse responses in humans, animals and plants in cases of overexposure. Many of the adverse responses are cumulative in nature, and hence solar UV related environmental risk assessment requires quantification of long-term exposures and large UV doses.

Dosimetry methods for quantifying solar UV radiation exposure are extremely versatile and cost-effective compared to radiometric methods, and allow time integrated doses to be quantified efficiently. Biodosimetry often provides a large dynamic range, but is expensive, labour intensive and time consuming. Chemical actinometry is a cost and labour effective alternative to biodosimetry, but is disadvantaged for large-dose measurements by its relatively small dynamic range.

Poly(dimethyl phenylene oxide) (PPO) film was identified from the literature as a chemical actinometer material with the potential to reduce the labour and costs involved in the quantification of large solar radiation doses by means of a larger dynamic range. A fabrication technique for PPO film actinometers was established, and the optical properties of the actinometers were fully characterised.

The resulting actinometer provides an efficient method for quantifying either unweighted UVB dose or biologically effective dose. The spectral response resembles the erythemal action spectrum, and the solar erythemal calibration function is near linear. The PPO film actinometer is therefore very well suited to human exposure research, especially for evaluation of chronic responses, or cumulative acute responses in which large-dose measurements are required.

The PPO film actinometer now provides an additional tool in the quantification of solar UV radiation exposure. It has equal versatility, and similar costs, labour and equipment requirements to the most commonly employed actinometry methods. The larger dynamic range of PPO film however, reduces labour and costs associated with large-dose UV measurements.

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