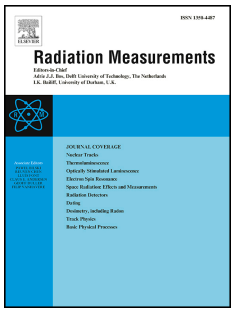
Accepted Manuscript



Luminescence characteristics of some common polyester fabrics: Application to emergency dosimetry

Lily Bossin, Ian K. Bailiff, Ian Terry

PII: S1350-4487(17)30408-0

DOI: 10.1016/j.radmeas.2017.05.017

Reference: RM 5802

To appear in: *Radiation Measurements*

Received Date: 30 September 2016

Revised Date: 18 April 2017

Accepted Date: 22 May 2017

Please cite this article as: Bossin, L., Bailiff, I.K., Terry, I., Luminescence characteristics of some common polyester fabrics: Application to emergency dosimetry, *Radiation Measurements* (2017), doi: 10.1016/j.radmeas.2017.05.017.

Luminescence characteristics of some common polyester fabrics: application to emergency dosimetry

Lily Bossin[a,b,c,*], Ian K. Bailiff[a], Ian Terry[b]

[a] *Department of Archaeology, Durham University, UK*
[b] *Department of Physics, Durham University, UK*
[c] *Radiation Metrology, Public Health England, Didcot, UK*

Abstract

A set of garment polyester-mix fabrics were tested for their potential suitability as surrogate dosimetry materials using optically and thermally stimulated luminescence techniques. A strong native blue-stimulated optically stimulated luminescence and thermoluminescence signal was observed with unirradiated samples, but this could be avoided by measurement of infra-red stimulated luminescence, and a sample of blue polyester-cotton mix fabric exhibited particularly high sensitivity to radiation dose. However, near complete fading at room temperature within several hours and rapid bleaching of the signal when exposed to daylight limit the deployment of this mode of measurement. The fading behaviour is critically dependent on the atmosphere in which the material is measured and on the storage conditions, where a reduction in oxygen significantly reduces the rate of fading. A cathodoluminescence study of the samples performed in a scanning electron microscope revealed complex emission spectra obtained with spatially integrated measurements and, in one fabric examined in more detail, the spatially resolved emission was found to vary in intensity and wavelength within the polyester fibre filaments which is likely to be associated with differences in crystallinity.

Keywords: Emergency dosimetry, OSL, TL, Polymers, Polyester fabrics

1. Introduction

Emergency dosimetry techniques aim to perform direct dose evaluations for affected members of the public in the event of a catastrophic radiation incident. Individuals exposed in these circumstances are unlikely to possess a dosimeter of the type issued to monitored radiation workers, and hence a primary objective in developing experimental techniques for emergency dosimetry is to identify suitable surrogate materials that potentially can be used to perform the function of cumulative external dose measurement to support rapid medical triage (e.g., Ainsbury et al., 2010; Bailiff et al., 2016). While progress has been made in the application of thermoluminescence (TL) and optically stimulated luminescence (OSL) techniques to ceramic substrates found within mobile phones for this purpose (Woda et al., 2009), other materials are being actively sought to widen the range of positions on the human body where dose determinations could be performed, including various types of polymers that are found in many types of clothing (Sholom et al., 2011; Sholom and McKeever, 2014). In the case of garment fabrics, they observed both a "native" signal and fading, with a loss at ambient temperatures in one week being ca 75% and 25%, depending on the sample.

In this paper we describe an investigation of the luminescence characteristics of a set of 26 fabrics sampled from a range of garment fabrics woven with natural, polyester and mixed fibres of differing colours with the aim

*Corresponding author: lily.bossin@durham.ac.uk