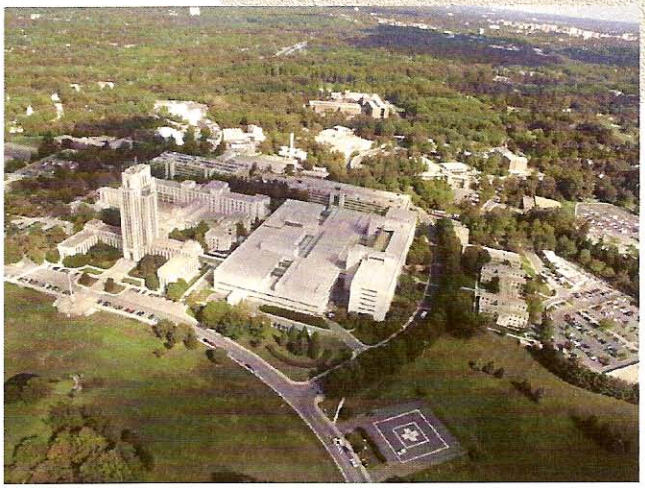
Scientific Program
BiodosEPR-2006

The 2nd International Conference on Biodosimetry and
7th International Symposium on EPR Dosimetry and Applications



Uniformed Services University of the Health Sciences (USUHS)
Bethesda, Maryland, USA
10-13 July 2006

Possibilities for Rapid, Portable, Non-Invasive Dosimetry of Radiation Events Using Optically Stimulated Luminescence in Dental Enamel

B. Pass[1,4] D. I. Godfrey-Smith[2] and P. Misra[3]

[1]Dept. of Diagnostic Services, Howard Univ. College of Dentistry, Wash., DC, 20059
[2]National Defense, Ottawa ON, K1A 0K2, CAN
[3]Dept. of Physics and Astronomy, Howard University, Washington, DC, 20059 USA

[4]Corresponding author: bpass@howard.edu

Currently, retrospective radiation dosimetry in humans lacks a technique that is sensitive, non-invasive, and portable. Without the ability to randomly sample and measure exposure in the general population, and to establish biodosimetric "truth," it is difficult to establish reliable cause and effect relationships between radiation exposure and resulting human detriment. In addition, in the event of an unanticipated radiation incident, such as a terrorist's radiation dispersal device or an accident at a nuclear facility, though a biopsy and tooth restoration technique has been developed, there is presently no means of triage dosimetry that can process mass casualties rapidly and non-invasively.

Of all living tissues, dental enamel is the only one that retains, essentially indefinitely, its radiation exposure history. The absorbed dose is stored in the form of long-lived free radicals (electrons freed by ionizing radiation, and subsequently trapped in lattice defects of the biological crystal hydroxyapatite).These free radicals have, historically, been detected using electron paramagnetic resonance (EPR). For adequate sensitivity, EPR requires a large laboratory magnetic field, and hence is an in-vitro, invasive technique requiring enamel obtained from discarded teeth. There have been, however, recent advances by Swartz in miniaturizing the EPR spectrometer and detecting free radicals in enamel of teeth non-invasively.

Since optical technology is amenable to miniaturization, a search for optically stimulated luminescence (OSL) in dental enamel was begun by this group. Godfrey-Smith and Pass (1997)[1] first reported a dosimetric effect using OSL in dental enamel. A time dependent OSL was observed under IR and green photon stimulation in gamma-irradiated samples of human dental enamel.

OSL of dental enamel can become the first non-invasive, simple, reliable, and portable means of retrospective radiation dosimetry in humans. The technique has been patented[2] and has recently received recognition, for its promise of rapid, non-invasive radiation dosimetry[3], through Department of Homeland Security funding of research by the Oakridge National Laboratory. This report will discuss potential obstacles to achieving portable, non-invasive OSL enamel dosimetry. Obstacles include low sensitivity, optical bleaching by sources of light external to the oral cavity, normalizing dose, signal fading, variations in opacity of enamel and in sensitivity to radiation-which can make it difficult to calibrate dose and establish a dose response curve.

[1]Godfrey-Smith, D. I. and Pass, B. A new method of retrospective biophysical dosimetry: optically stimulated luminescence and fluorescence in dental enamel Health Phys. 72(3):744-749 (1997).
[2]USPN 5,818,056: Optically Stimulated Luminescence Dosimetry in Dental Enamel
[3]Pass, B. Godfrey-Smith, D. I., Scallion, P. Retrospective Radiation Dosimetry Using Optically Stimulated Luminescence in Dental Enamel: Possibilities for *Invivo* Dosimetry. Proceedings of the 36th Midyear Topical Meeting "Radiation Safety Aspects of Homeland Security and Emergency Response" Health Physics Society, San Antonio, Texas, 210-217, (January 27-29, 2003).