OSL of Personal Belongings and *in vivo* Materials and their Potential Use in Accident Dosimetry

Geber-Bergstrand T., Bernhardsson C., Mattsson S., Rääf C.L.

Department of Clinical Sciences Malmö, Medical Radiation Physics, Lund University, Sweden

1. INTRODUCTION

A radiological emergency situation will require dose assessment of potentially exposed people in order to rapidly carry out proper remedial actions and medical treatments as well as to inform people about their exposure situation. The use of materials in, or close to, the body would be very useful since this would provide an individual dose estimate. The optically stimulated luminescence (OSL) technique uses light to stimulate a sample of such material and a photomultiplier tube to detect the luminescence light, which originates from the recombination of radiation-induced charges trapped at metastable defects in the material.

- **We are investigating the OSL properties of various types of materials; household salt, tooth enamel, dental repair materials and components from mobile phones, to determine if they are suitable accident dosimeters.**
- **We show the results of two different ways of estimating the minimum measurable dose (MMD) and the associated uncertainties.**

2. MATERIALS & METHODS

Read-out of the OSL were performed using a TL/OSL reader (TL/OSL-DA-15; Risø National Laboratory, Roskilde, Denmark). A variety of radiation sources were used; a $^{90}Sr/^{90}Y$ beta source (~0.9 mGy s^{-1}), a linear accelerator (6 and 10 MV), gamma sources (e.g. ^{60}Co, ^{137}Cs) and a ^{241}Am alpha source.

Fading measurements were made on four types of dental repair materials (two composites and two ceramics) were made by recording the OSL signal at different times after irradiation. Dose-response measurements were made by irradiating the samples using both a $^{90}Sr/^{90}Y$ (<10 Gy) beta source and a linear accelerator (≤10 Gy).

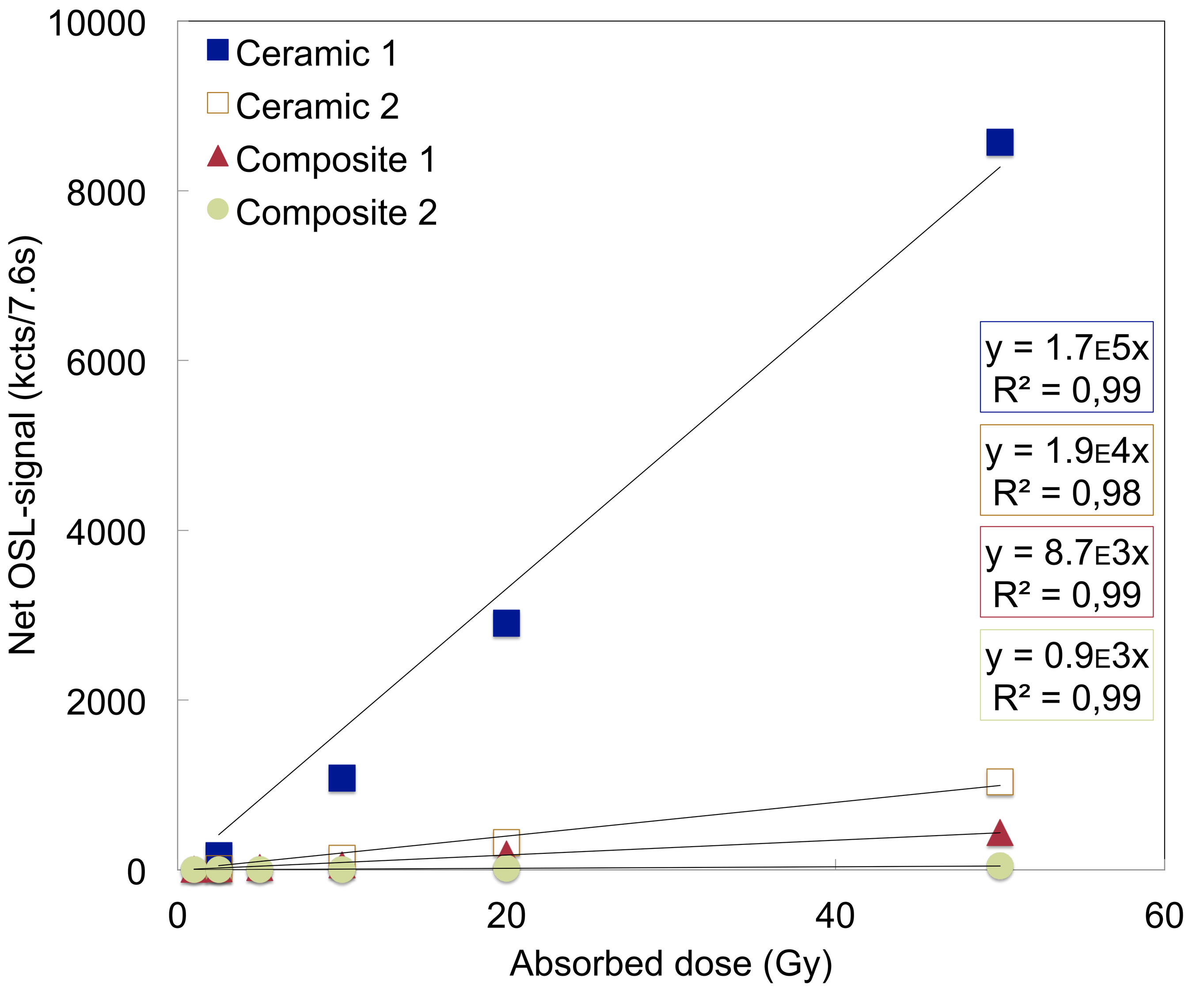
Traditionally, the MMD is calculated according to

$$MMD_{simple} = \frac{1}{S} \cdot 3\sigma_{\overline{OSL_{zero}}} \quad .$$

The sensitivity, S, i.e. the signal per unit absorbed dose, of a material is obtained by the slope of the dose-response plot. In order to also take the uncertainty of the linear regression into account we also calculated the MMD by means of

$$MMD_{extended} = 3\sqrt{\left(\frac{-\overline{OSL_{zero}}}{S^2}\right)^2 \cdot \sigma_S^2 + \left(\frac{1}{S}\right)^2 \cdot \sigma^2_{\overline{OSL_{zero}}}} \quad .$$

	MMD (mGy)	
Material	**Simple**	**Extended**
Ceramic 1	69	69
Ceramic 2	52	182
Composite 1	14	18
Composite 2	468	1296



3. RESULTS

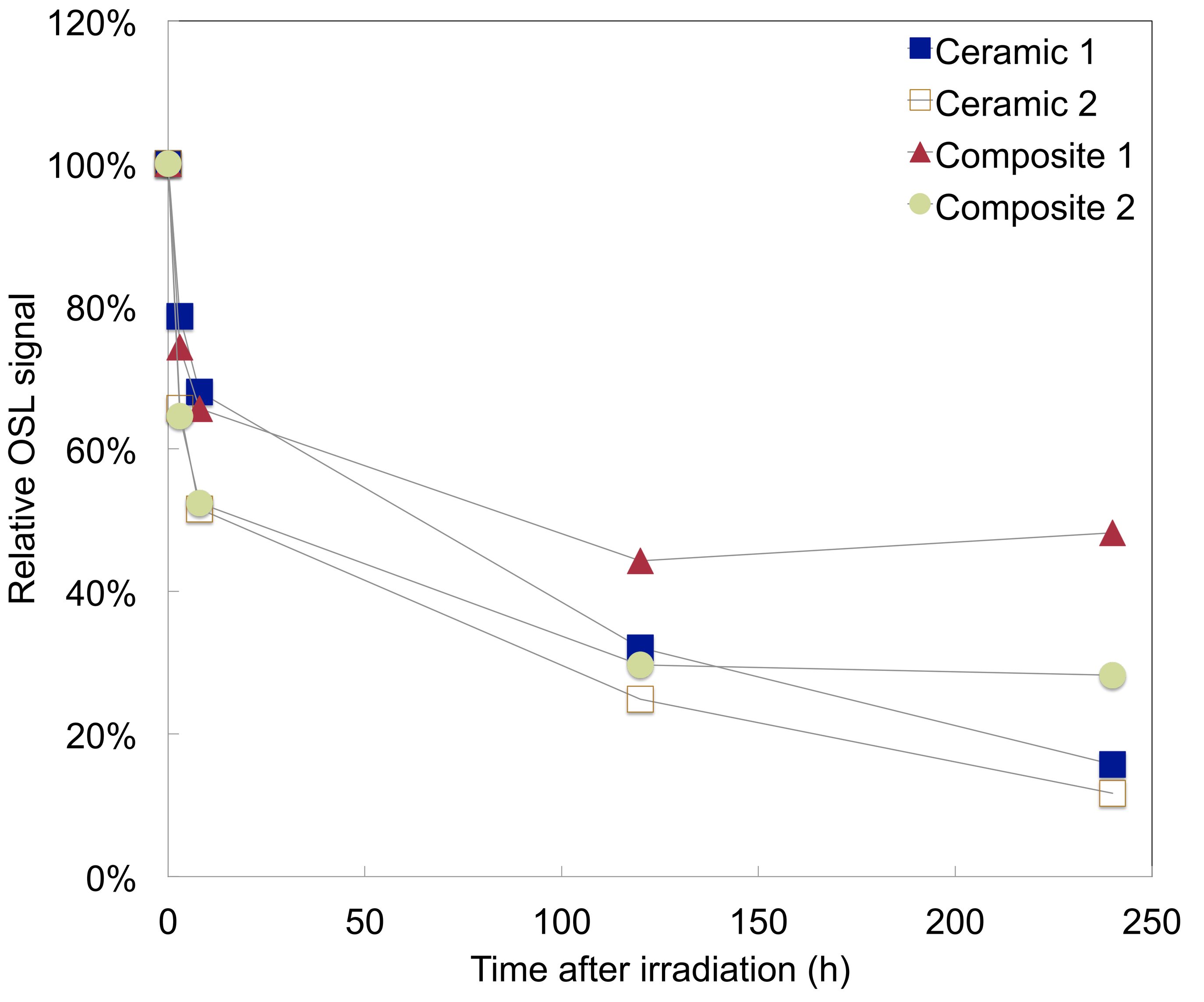
The fading characteristics are in agreement with most other materials used in OSL with an initially fast and subsequently more slow fading rate. The composite materials seem to level out somewhat after 120 h while the ceramics continue to fade also after 120 h.

All of the materials show a linear dose-response and high sensitivities, especially one of the ceramics.

A high sensitivity is desirable since it in general corresponds to a lower MMD.

The uncertainties considered in the estimation of the MMD may generate significant variations.

It is evident that the MMD does not exclusively depend on the sensitivity, since Composite 1 has the lowest MMD but the third highest sensitivity.



4. CONCLUSIONS

Several of the investigated materials show promising properties for accident dosimetry. Dental repair materials, potentially read-out *in vivo*, may be very useful in the case of a radiological emergency situation.

Depending on the uncertainties taken into consideration when calculating the MMD, the results may vary considerably.

LUND UNIVERSITY

IRPA 13
13-18 May 2012
Glasgow, Scotland

Therése Geber-Bergstrand, PhD student
e-mail: therese.geber@med.lu.se
Phone: +46 40 325 67