WHAT CAN WE ACHIEVE BY APPLYING OPTICAL STIMULATION OF LUMINESCENCE DURING HEATING?

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Abstract

Up to now, the methods of OSL measurements, when used for trap investigations, have relied on recording the luminescence decay during the optical stimulation with a constant energy *hn* and a constant (Continuous Wave OSL, CWOSL) or linearly increased (Linearly Modulated OSL, LMOSL) flux of stimulation photons *f*. During these measurements the ratio of probabilities of the optical release of electrons from traps ($f = f\ s$) that have different optical crosssections *s1* and *s2* is constant: *f s1 /f s2 = const*, because the *s1* and *s2* remain constant at constant temperature and constant stimulation energy. This causes that it is hard to separate the signal originating from different traps. In particular, the initial optical emptying of shallower traps before investigating the deeper ones does not bring good results (Kijek and Chruścińska, 2014), contrary to the TL analysis where the initial thermal emptying of shallow traps is a usual treatment when a signal from deep traps is going to be tested. In TL measurements, the ratio of probabilities of the thermal release of electrons from different traps changes in such a way that it is possible to empty the shallow traps effectively without depopulating the deeper traps. As it was shown recently, similar advantageous changes of the probability ratio during the OSL experiments, and in consequence more information about the trap than only the OCS value, can be obtained by inducing the changes of OCSs by increasing the stimulation energy (Variable Energy of Stimulation OSL, VESOSL) (Chruścińska, 2014). This method requires a strong tuneable light source that supplies stable flux of photons during the stimulation energy changes and, presumably, because of this the VESOSL cannot be widely used. Such limitations, however, do not concern the possibility of inducing the OCSs changes by increasing temperature. Such a technique can be realised by means of standard OSL readers after a slight modification.

The method of experiment that is going to be presented here is somewhat related to a measurement called thermooptical luminescence (TOL) (H́utt et al., 1988; Duller, 1997), however, a difference between the proposed regime of stimulation and TOL should be noticed. In the TOL experiment the OSL signal is stimulated by short (e.g. 0.1 s) pulses every few degrees (e.g.10∘C) during linear heating (a few degrees per second) in order to test the OSL intensity at higher temperature. In this way the thermal assistance effects can be investigated. Here a continuous stimulation is used in order to cause the OCS changes during the stimulation and generate the OSL curve shape that can help to obtain more information about the trap, e.g. the optical depth of trap and the electronphonon coupling parameters, in the framework of the simplest OSL models. Although it was earlier shown how OCS

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depends on temperature (Chruścińska, 2010), this work, beside its main aim, gives a deeper insight in the character of this dependence and its relation with trap parameters.

The main objective of this work is to demonstrate what possibilities gives the optical stimulation during heating. The effects that the experimental parameters such as heating rate, stimulation light intensity and stimulation energy have on the OSL curve shape and its position on the temperature axis have been investigated in wide ranges of the relevant parameters. It turns out that all three factors can be the very useful tools for the regulation of OSL curve. By this kind of stimulation one can reach very deep traps that are not detectable by TL below 500∘C. The resolution of the OSL signal originating from different traps is remarkable.

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