Title: Ultra-violet annealing of optically stimulated luminescent dosimeter

Innovation/Impact: We are developing a new annealing method using ultra-violent (UV) light for optically stimulated luminescent dosimeter (OSLD) to remove the dependence of the dose response on the history of irradiation. This allows the use of OSLD for periodic output constancy check of radiation producing machines without the uncertainty introduced by variation of sensitivity among different dosimeters.

Supporting data: We irradiated a nanoDot OSLD with 14 Gy of 6 MV x-ray. We used an un-irradiated OSLD as control for comparison. It is well known that after irradiation with x-ray and annealed by illumination with visible light the optically stimulated luminescent (OSL) signal regenerates\(^1\), i.e. the OSL signal gradually increases. The regeneration rate is the rate of increase of the OSL signal in counts/hour. The regeneration is due to charge trapped in deeper traps transferring to the dosimetry trap\(^1\). We found that after illumination with UV light the OSL signal also gradually changes. However, the sign of the change depends on the amount of x-ray irradiation.

We divided the annealing process into multiple sessions. Each session consisted of a 15 minute illumination with a high power blue light-emitting diode (LED) and a period of illumination with a UVC light source. Regeneration rates after the illuminations were recorded at different cumulated UVC illumination durations with a microStar OSLD reader. Results are shown in the following figures.

\[\text{regeneration rate (counts/hr)}\]
\[\text{cumulated UV illumination time (hours)}\]

![Fig. 1](image1.png) Regeneration rate of OSL signal upon termination of UV illumination. The rate of the irradiated OSLD approached that of the un-irradiated OSLD as it is illuminated by UV light. The rate of the un-irradiated OSLD was practically unaffected by UV light.

![Fig. 2](image2.png) Regeneration rate of OSL signal after LED illumination. The rate of the irradiated OSLD approached that of the un-irradiated OSLD as it is illuminated by UV light. The rate of the un-irradiated OSLD was practically zero, i.e. the OSL signal was constant.

All regeneration rates shown in Fig. 1 were negative, i.e. the OSL signals were decreasing with time after UV illumination. However, after LED illumination, the regeneration rates were positive. The magnitude of the regeneration rate was about an order of magnitude lower. After 56 hours of UV illumination and 15 minutes of LED illumination, the OSL signal of the irradiated OSLD was increasing at a rate of less than 4 counts per hour.