

Purpose: To determine the response of beryllium oxide (BeO) optically stimulated luminescence (OSL) detectors in diagnostic radiology and to develop a protocol for proper handling and readout.

Methods: The BeO OSL detectors used in this study are ~4.7 mm x ~4.7 mm x 0.5 mm chips and weigh ~32 mg each (Thermalox 995, Brush Ceramic Products, Brush Wellman, Inc.). Detectors were annealed at 700 °C for 15 minutes prior to irradiation and protected from light. The dose response, minimum detectable dose, and reproducibility were determined using ⁹⁰Sr/⁹⁰Y beta sources. Clinical irradiations were performed at OUHSC with a radiographic unit (Proteus XR/a, GE Healthcare). A 6 cm³ ionization chamber (model 10X5-6, Radcal Corporation), Al₂O₃:C OSLDs (Luxel™, Landauer, Inc.), and LiF:Mg,Ti (TLD-100, Thermo Fisher Scientific, Inc.) were also used for comparison. The relative response of each type of detector was determined by varying the preset tube voltage of the radiographic unit from 50-130 kVp. The OSL and TL signals were read using a Risø TL/OSL-DA-15 automated reader (Risø National Laboratory), which uses continuous blue stimulation for the OSL measurements.

Results: BeO was found to be very sensitive, with a minimum detectable dose of ~20 µGy using the Risø OSL reader. The dose response is linear up to ~5 Gy, and the reproducibility using a proper methodology is less than 1.2 %. BeO under-responds to low energy photons by a factor less than 20% relative to 130 kVp, whereas Luxel™ over-responds to low energy photons by a factor less than 40% relative to 130 kVp.

Conclusions: This study demonstrates the dosimetric properties of BeO for applications in diagnostic radiology and indicates that BeO may require energy correction factors to be applied.

Funding Support, Disclosures, and Conflict of Interest:

Disclosure: Stephen Eller was supported by ProCure Treatment Centers, Inc.