

Abstract Submitted
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Measurements of Thermally Stimulated Luminescence in Gamma-Irradiated Ultra-High Molecular Weight Polyethylene in the Presence of Vitamin E¹ DEREJE ABDI, MUHAMMED JAHAN, BENJAMIN WALTERS, University of Memphis — Thermally stimulated luminescence (TSL) was detected in medical grade ultra-high molecular weight polyethylene (UHMWPE) GUR 1020 (Ticona) after gamma irradiation at room temperature (22°C) in air or nitrogen and subsequent heating from 22°C to 399°C using a commercial TSL apparatus (Thermec). A typical TSL glow curve exhibits two major glow peaks near 116°C and 200°C with a weak shoulder near 250°C. Additional glow peak is observed near 140°C in GUR 1020E (UHMWPE containing 0.1% vitamin E (alpha-tocopherol (α -T))). Full-width-at-half-max (FWHM) and activation energy for each peak were found as follows. 116°C: 40°C, 1.2 eV; 140°C: 40°C, 1.3 eV; 200°C: 64°C, 1.0 eV; 250°C: 56°C, 1.5 eV. The glow peaks seem to follow a kinetic order of 1.5. While the 116-°C glow is produced in all irradiated samples, the 200- and 250-°C peaks are produced when irradiation is performed in air, suggesting that these latter glow peaks are associated with the oxygen-centered species and the former (at 116°C) with polyethylene (PE) radicals. The 140-°C peak could result from thermal breakdown of vitamin E radical (α -T-O*). Irradiation dose, 30, 65 or 100 kGy, simply changes the TSL intensity without affecting the TSL characteristic. Vitamin E, which is used as an antioxidant, does not seem to affect the TSL in UHMWPE.

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