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Measurements of Long-Lived Radicals in Ultra-High Molecular Weight Polyethylene¹ MUHAMMAD JAHAN, MUHAMMAD FUZAIL, MARLON RIDLEY, BENJAMIN WALTERS, Department of Physics, The University of Memphis, TN 38152 — Ultra-high molecular weight polyethylene (UHMWPE), a polymer of choice for orthopedic applications, was gamma-irradiated in air, nitrogen or vacuum at 22 ° C and subsequently aged for 10 years in its own environment at 22 ° C, 37 ° C, or 75 ° C. Free radical measurements were conducted using an X-band electron spin resonance (ESR) spectrometer. The samples aged in sealed environments (nitrogen or vacuum) show the presence of the primary radicals (alkyl, allyl, polyenyl), although the concentration of these radicals in each case is very low to insignificant. However, there is no detectable transformation from the primary to oxygen-induced radicals (OIR). The ESR spectra of the open samples, on the other hand, show the presence of only OIR. Similar OIRs are detected in retrieved hip- and knee-joint parts 18 years after retrieval. These joints were gamma-irradiated in air prior to implantation, and were retrieved 6-8 years after use. OIRs are also detected in vitamin-E-doped UHMWPE after gamma irradiation in nitrogen and subsequent exposure to air for one year.

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