THE RADIATION CHEMISTRY OF SYMMETRIC ALIPHATIC POLYESTERS

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Naturally occurring, symmetric polyesters, including polyglycolic acid, polylactic acid and polyhydroxybutyrate, have found biomedical applications in areas as diverse as the controlled release of pharmaceuticals and the manufacture of surgical sutures. As biomedical products, the materials require sterilization by high energy radiation. This has provided the motivation for the present work.

D'Alelio et al. have reported that linear, asymmetric polyesters undergo scission on irradiation, but that branched polyesters containing a methyl group in the diol segments undergo crosslinking. However, for the symmetric polyhydroxybutyrate, Carswell-Pomerantz et al. have reported that only scission occurs on radiolysis, with the evolution of CO and CO_2 as a result of the loss of ester linkages. These workers also found that $G(CO + CO_2)$ was approximately equal to G(S) for this polyester. By contrast, Collett et al. have reported that $G(S) = 1.26$ and $G(X) = 0.53$ for polylactic acid, which indicates that the polymer undergoes nett crosslinking on radiolysis to form a gel. They have also reported that poly(lactic-co-glycolic acid) should form a gel on radiolysis, since $G(S) = 1.66$ and $G(X) = 0.65$ for a 1:1 copolymer composition.

In the present work the radiolysis of polylactic acid and poly(lactic-co-glycolic acid) have been reinvestigated in order to resolve the differences between the work of Collett et al. and that of Carswell-Pomerantz et al. In these studies, ESR has been used to study the radicals formed, GPC has been used to investigate scission and crosslinking, GC has been used to study the small molecule volatile products and NMR spectroscopy has been used to identify and measure the new chemical structures formed in the polymers.

References:

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