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Investigation of hydrophilic materials as hypoxic phantoms

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Cross-linked hydrophilic co-polymers are candidates for use as phantom materials because they can be modified to have similar elemental compositions to that of body soft tissues. Co-polymers contain both hydrophobic and hydrophilic monomers; the molar ratio of which allows the water-uptake ability to be controlled. By controlling the hydration level, it may be possible to imitate various types and different disease stages of tissues, as well as the extent of tissue hypoxia. A series of experiments was carried out for different types of cross-linked hydrophilic co-polymers; hydroxyethyl methacrylate/Vinyl pyrrolidone (HEMA-VP) and methyl methacrylate/Vinyl pyrrolidone (MMA-VP) were hydrated by biological fluids with or without the reducing agent AnaeroGen to obtain hypoxic condition or normoxic condition; respectively. The relative yield of 3γ -to- 2γ annihilation photons was determined using the positron emitter, Na-22, with a lanthanum bromide: Cerium (LaBr₃:Ce[5%]), scintillation detector. The peak-to-peak method was used to calculate the ratio of the full-energy photopeak area of the 511keV annihilation obtained in the sample and the aluminium reference material. The Na-22 source used has a positron yield of 90.4% and a gamma-ray energy at 1274keV of relative intensity 99.9%, emitted almost simultaneously. The energy resolution and the intrinsic photopeak efficiency figures for LaBr₃:Ce were $(3.37\pm 0.08)\%$ and $(29.1\pm 0.8)\%$, respectively for the 511keV annihilation energy. The relative yield of 3γ -to- 2γ annihilation photons was calculated and discussed in different hydrophilic co-polymers.

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