

Assessment of polybutadiene and polystyrene rubbers for medical-industrial high-dose radiation dosimetry - Preliminary study

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Radiation dosimetry for medical and industrial purposes has increasingly evolved over the last few decades with the introduction of various new detectors. Depending on the properties exhibited for radiation dosimetry, some detectors have their applications in a specific area. From a physics point of view, an ideal dosimeter should be able to measure absorbed dose (energy absorbed per unit mass). Here, synthetic materials based on Polybutadiene and Polystyrene rubbers were proposed as a new class of radiation-detectors. The influences of radiation dose on its properties have been investigated for application in high-dose dosimetry. The rubber samples were exposed to absorbed doses of irradiation range from 10 Gy up to 10 kGy using a ^{60}Co Gamma Cell-220 system (dose rate of 1.089 kGy/h). Their responses were carried out with a Fourier Transform Infrared Spectroscopy-FTIR system to investigate the presence of absorbance peaks, in the region 400-4000 cm^{-1} at a spectral resolution of 1 cm^{-1} . Spectral processing performed normalization of the data. In this step, all absorbances in the spectrum are divided by the largest absorbance in present. Two mean absorbance peaks were taken for each kind of rubber spectrum to be analyzed by ratios of Polybutadiene (1306/1130 cm^{-1}) and Polystyrene (1449/1306 cm^{-1}). The results, has suggested the existence of a supra-linear dose-response relationship between the calculated ratio and absorbed dose. For both polymers, the dose-response curves may be useful for high-dose dosimetry (greater than 250 Gy). The standard deviations for the reproducibility of the method were lower than 2.5%. The relative sensitivity was little higher for the Polystyrene (1.86 kGy^{-1}) than Polybutadiene (1.81 kGy^{-1}). Doses range from 10 kGy up to 200 kGy, was not found variation in the dosimetric response. The two classes of rubber samples showed usefulness as high-dose dosimeters.