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# ETHYLENE-VINYL ACETATE DETECTOR EXPOSED TO GAMMA RADIATION AND EVALUATED *VIA* PRINCIPAL COMPONENT REGRESSION

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**Introduction:** Applications of ethylene-vinyl acetate (EVA) have been reported in radiation physics research, such as in electron beam irradiations, UV measurements and microwave irradiations. Gamma radiation is well known and presents several applications for radiation dosimetry [1]. The evaluation of EVA and other dosimeters can be undertaken by the Fourier Transform Infrared (FTIR) spectrophotometry technique. The goal of this work was to investigate the effect of gamma radiation in green, white and black EVA dosimeter samples for their sensitivity and linearity response, using the PCR method, and evaluated with the FTIR spectrophotometry technique.

**Material and method:** The EVA samples had dimensions of 0.5 x 0.5 x 0.1 $cm^3$, in colors green, white and black. These samples were irradiated in triplicates, with absorbed doses of 0.01 kGy, 0.05 kGy, 0.10 kGy, 0.25 kGy, 0.50 kGy, 1.0 kGy, 5.0 kGy and 10.0 kGy using a $^{60}$Co Gamma Cell-220 system (dose rate of 1.089 kGy/h of the Radiation Technology Center of IPEN); afterwards, the absorbance spectrum of each sample was acquired on a Fourier Transform Infrared (FTIR) spectrometer (Frontier/Perkin Elmer) from 400 $cm^{-1}$ to 4000 $cm^{-1}$, with 1 $cm^{-1}$ spectral resolution.

The linearity of response was evaluated using the Pearson correlation coefficient ($R^2$). The sensitivity was set as the linear coefficient from a simple linear regression that was fitted using the Ordinary Least Squares Method between the absorbed doses and absorbance values for each wavenumber in the spectra for all colors of EVA samples.

The PCR method combines all spectra from absorbance measurements into a single matrix, called here as $X_{nm}$, where n is the absorbed doses that varied discreetly from n = 1 up to 8, matching the absorbed doses of 0.01 kGy, 0.05 kGy, 0.10 kGy, 0.25 kGy, 0.50 kGy, 1.0 kGy, 5.0 kGy and 10.0 kGy, m is the spectral resolution index, from m = 1 up to 3600, equivalent to the range from 400 $cm^{-1}$ to 4000 $cm^{-1}$.

**Results**: Predicted absorbed dose *versus* absorbed dose data are shown in Figure 1, for the PCR method, for EVA samples of all colors. The $R^2$ obtained was 1.000 for the PCR method. It can be inferred that these methods are a good alternative, in the applications that require assessing linearity response in dosimetry, since the measurements from each kind of sample may be transformed in linear results. Consequently, these methods can be associated with other characteristics from radiation dosimetry as: reproducibility, fading, spatial resolution and others.

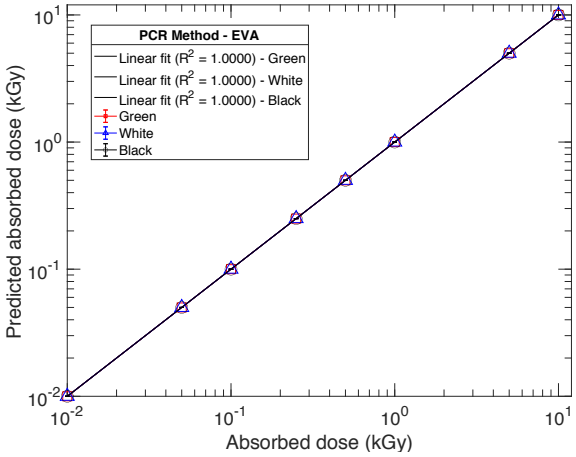


Figure 1: Predicted absorbed dose *versus* absorbed dose; for: green, white and black EVA samples.The uncertainty obtained was lower than 1%, not visible in the figure.

**Conclusion:** EVA samples can be considered as a promising material for measurements of high doses of gamma radiation.

**Reference:**

1. Ahmed, J., Wu, J., Mushtaq, S., Zhang, Y., *Materials Today Communications* **23**, 1–5 (2020).