ANGULAR RESPONSE OF POLYMER FILMS IRRADIATED WITH ACCELERATED ELECTRON BEAM

Ana Maria Sisti Galante, Letícia Lucente Campos

Instituto de Pesquisas Energéticas e Nucleares, IPEN-CNEN/SP
Av. Prof. Lineu Prestes, 2242 Cidade Universitária, São Paulo-SP, Brasil 05508-000
e-mail: sgalante@ipen.br, lcrodri@ipen.br

1. INTRODUCTION

Incident electrons on material or on patient are characterized by its different parameters of energy, incidence angle and particles average range in a specific medium. When radiation is applied over a large area as in the skin diseases treatment or in the industry which large and irregular volumes should be irradiated, obliquely incident particles must be considered, since, this fact can result in different doses from those obtained irradiating material on normal direction exposure.

Polymer films present fast and inexpensive mean for performing accurate quantitative radiation dosimetry.

Ionizing radiation interaction: polymeric materials undergo structural changes due to molecular cross-linking and chain scission (degradation) reactions. It involves effects in the direct color change by the absorption of energetic radiation.

Dosimetric Response: optical absorbance changes of the irradiated film for specific wavelengths, can be related with the absorbed dose.

2. OBJECTIVE

➢ **To evaluate the angular dependence on the radiation detector response for different electron beam incidence angles.**

3. MATERIAL

Film pieces: - *Polycarbonate* (PC), *Polymethylmetacrylate* (PMMA),
(3 x 1 cm^2) - *Cellulose Triacetate* (CTA), *Polyvinylchloride* (PVC),
- *Fluoropolymer* (PF).

4. EXPERIMENTAL

1- Electron accelerator
Dynamitron® Job 188 - RDI- Radiation Dynamics Inc.

2. Electron energies - 0.732 and 1.25 MeV
Absorbed doses - 10 and 30 kGy

3. Samples positioning

✓ normal direction exposure: horizontal – parallel to conveyor
✓ Angles: 30, 60 e 90º.

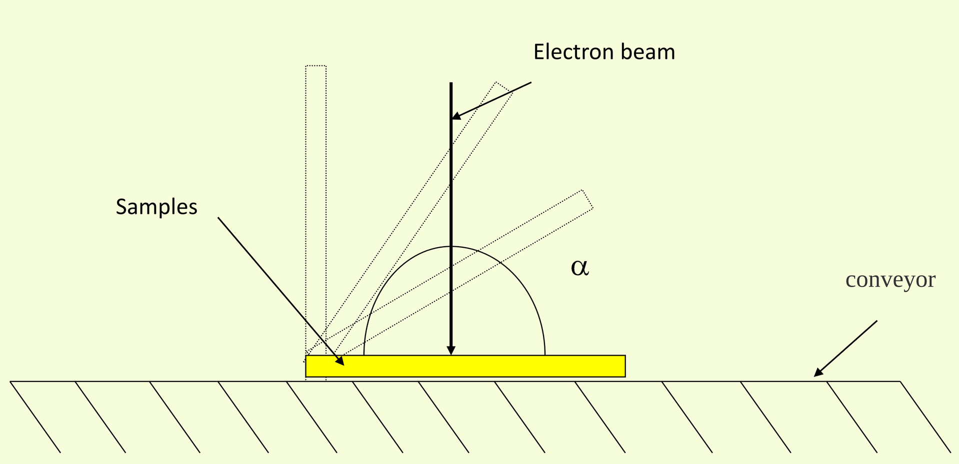

Figure 1. Schematic drawing of the positioning of samples.

4. Sample Box irradiation

✓ Absorbed dose - 30 kGy
✓ Electron energy - 0.732 MeV
✓ Legend:
- PC detector – position 90º
- PC detector – position 60º
- PC detector – position 30º
- PC detector – position 0º

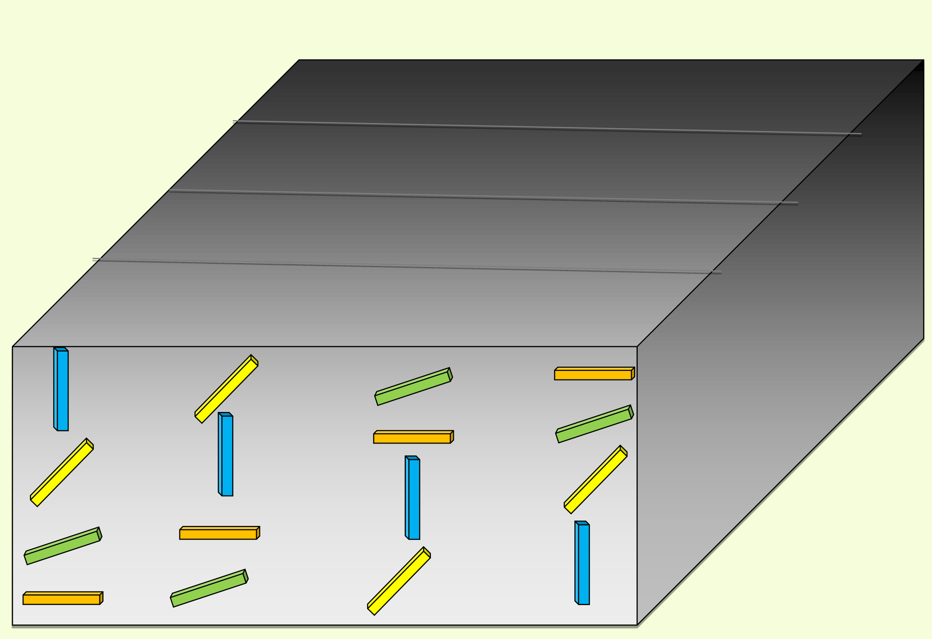

Figure 2. Schematic drawing of the sample box irradiated with PC detectors positioned at different angles and spread over the container volume. Front face shown.

5. Results and Discussion

▪ Incidence angle different from 0° ⟶ delivered dose decreases with the angle increasing.
Normal incidence ⟶ little dispersion around the medium.

▪ The PFA detector not sufficiently sensitive.

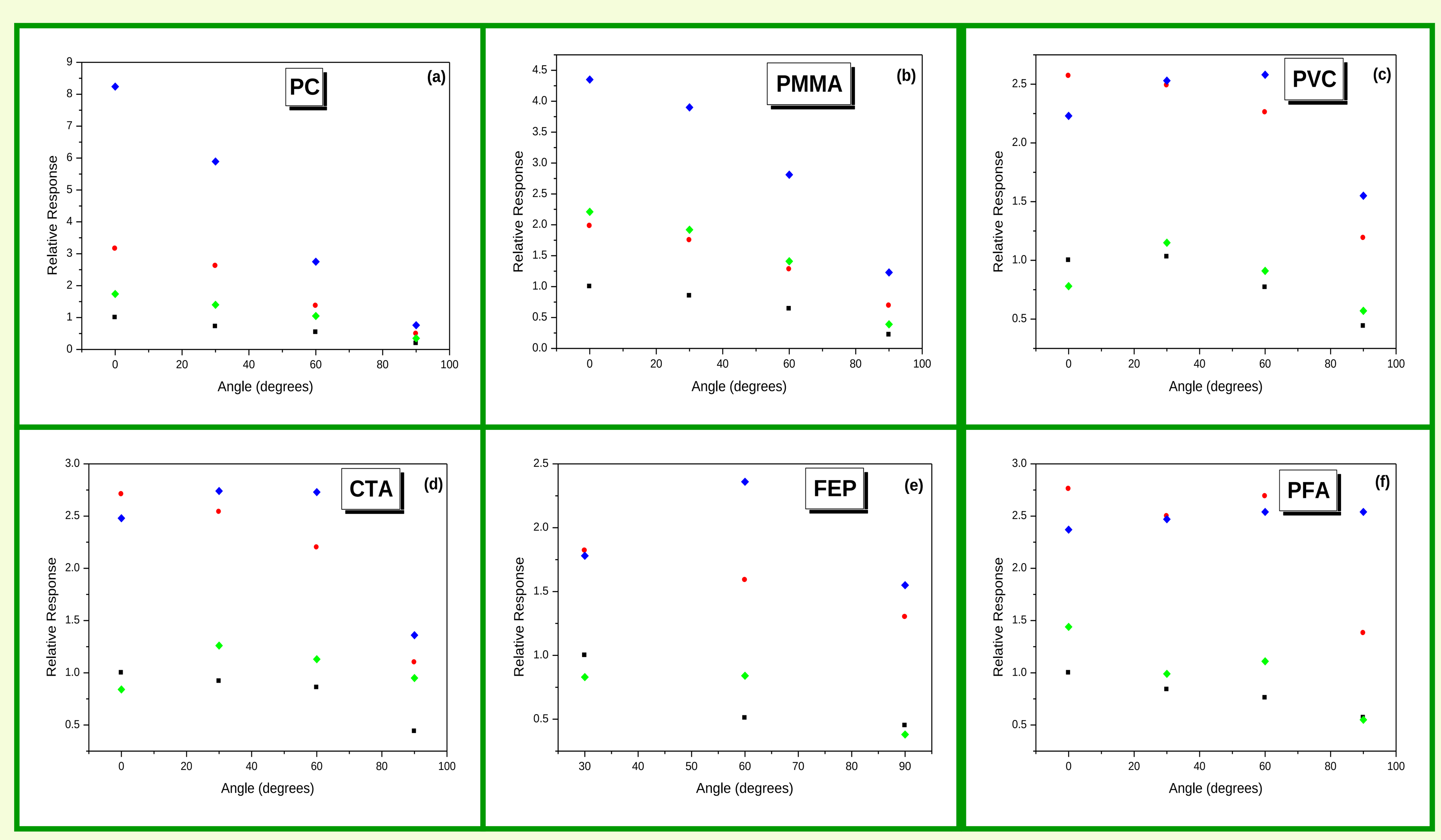

Figure 3: Relative Optical Response of detectors
▪ Energy= 0.732 MeV e Dose = 10 kGy; • Energy = 0.732 MeV e Dose = 30 kGy;
• Energy = 1.250 MeV e Dose = 10 kGy e ♦ Energy = 1.250 MeV e Dose = 30 kGy.

Box electron beam irradiated

- Material in the box surface positioned obliquely: dose penetration decrease (received dose - 83%, 43% and 15% respectively to angles of 30, 60 and 90º);
- Bottom position box – absorbed dose < 5% than normal position, and
- Detectors obliquely positioned(90º) – absorbed dose aprox. zero

6. Conclusions

✓ Material obliquely positioned receives: lower dose.

✓ The results obtained have comproven that all tested detectors (with the exception of the PFA polymer) are effective in the mapping of received radiation dose distribution in electron beam irradiation in different configurations (angles).

✓ Simulations and planning systems are used to guarantee that the doses are obtained in reference geometries with an adequate precision.

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