NUCLEAR RADIATION SHIELDING PROPERTIES OF ER+3 AND SM+3 DOPED ZINC BORATE GLASSES: A FOCUSING RESEARCH ON SUITABILITY FOR DIAGNOSTIC RADIOLOGY FACILITIES

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AIM

The aim of this research is to investigate highly-efficient, eco-friendly shielding materials that can be utilized in nuclear medicine facilities instead of lead and lead-based compounds. Nine different zinc borate glasses from the system: BaO: ZnO: B2O3:Tv2O3 (where Tv = Sm, and Eu) were extensively investigated for crucial nuclear shielding properties.

INTRODUCTION

Traditional shielding materials such as lead & concrete have been used extensively in nuclear medicine as radiation shields, but these are non-eco friendly, toxic, have reduced visibility etc.Subsequently, new radiation shielding systems that are corrosion resistant, biocompatible, and can be formed into compact designs with high structural integrity and durability are required.Glass materials are a proposed solution for use as radiation shields because of their unique properties which make them effective in blocking high energy radiation like x and gamma radiation

MATERIAL & METHODS

Py-MLBUF

Py-MLBUF online platform was utilized to determine some essential parameters in 0.015 MeV-15 MeV photon energy range. Origin software was used for graphing and analysis

NUCLEAR SHIELDING PROPERTIES

- Linear attenuation coefficient (LAC).
- Mass attenuation coefficient (MAC).
- Half value layer (HVL).
- Tenth value layer (TVL).
- Mean free path (mfp).
- Effective atomic weight (Aeff).
- Effective atomic number (Zeff).
- Effective number of electrons per gram (Neff).
- Effective conductivity (Ceff).
- Buildup factors (BUF).

RESULTS

The results showed that the type of rare-earth oxide has a direct effect on behaviors of the zinc-borate glasses against ionizing gamma-rays. Our findings revealed that Eu reinforced zinc-borate glass composition namely BaO:ZnO:B2O3:Eu2O3 with a glass density of 3.512 g/cm3 was reported with superior gamma-ray attenuation properties as it had the highest LAC, MAC, Ceff, Neff, and Zeff values as well as the lowest HVL, TVL, MFP, EBF & EABF values.

CONCLUSION

From the results, it can be concluded that the effect of Eu is superior when compared to Sm in terms of radiation attenuation competencies. The literature review showed that different types of investigations are being considered by researchers in terms of adding rare-earth for nuclear radiation shielding improvements. The results of this study could be further used to aid the scientific community in determining the most appropriate rare-earth additive, to provide adequate shielding properties based on the requirement.