Title	**Investigation of Radiation Shielding Properties of Modified Polymer Systems Using Geant4 Modelling Software**
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Abstract	The development of lightweight, flexible, and lead-free materials for radiation shielding is becoming in- creasingly important in medical, industrial, and nuclear applications. This study evaluates the gamma- and neutron-shielding performance of polyethylene glycol (PEG) polymers with molecular weights ranging from 1 k to 200 k. Gamma-ray attenuation coefficients were measured experimentally and validated against analytical predictions obtained from the EpiXS photon-interaction database and Monte Carlo simulations performed using the Geant4 toolkit. Neutron-removal cross sections were computed exclusively using Geant4 due to the nuclear nature of neutron interactions. The results showed excellent agreement between experimental measurements and computational predictions, with an average deviation of less than 1–2% across the full photon-energy range (0.01– 20 MeV). All PEG samples exhibited the characteristic decrease in attenuation with increasing energy. Higher–molecular-weight polymers, particularly PEG 200k, demonstrated superior gamma- and neutron-shielding performance, while PEG 1k showed the lowest attenuation efficiency. These trends reflect the influence of polymer density, hydrogen content, and molecular-chain structure on radiation-interaction behavior. Overall, the findings confirm that high–molecular-weight PEG systems offer strong potential as efficient, non-toxic, and lightweight alternatives to conventional shielding materials. Their predictable attenuation characteristics make them suitable candidates for mixed-radiation environments, including medical imaging, radiotherapy, and industrial radiation applications.
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