

X-Ray Shielding Properties of Bismuth-Borate Glass Doped with Rare-Earth Ions

Authors : Vincent Kheswa

Abstract : X-rays are ionizing electromagnetic radiation that is used in various industries such as computed tomography scans, dental X-rays, and screening freight trains. However, they pose health risks to humans if they are not shielded properly. In recent years, many researchers around the globe have been searching for nontoxic best possible glass materials for shielding X-rays. In this work, the x-ray shielding properties of $45\text{Na}_2\text{O} + 10\text{Bi}_2\text{O}_3 + (5 - x)\text{TiO}_2 + (x)\text{Nb}_2\text{O}_5 + 40\text{P}_2\text{O}_5$, where $x = 0, 1, 3, 5$ mol%, glass materials were studied. The results revealed that the glass sample with the highest TiO_2 content has the highest mass and linear attenuation coefficients and lowest half-value thickness, tenth-value thickness and mean-free path in the 20 to 80 keV energy region. The sample with 3 mol% of Nb_2O_5 has the highest mass and linear attenuation coefficients and the lowest half-value thickness, tenth-value thickness, and mean-free path at 15 keV and photon energies between 80 to 300 keV. It was, therefore, concluded that $45\text{Na}_2\text{O} + 10\text{Bi}_2\text{O}_3 + 5\text{TiO}_2 + 40\text{P}_2\text{O}_5$ glass is best for shielding x-rays of energies between 20 and 80 keV, while $45\text{Na}_2\text{O} + 10\text{Bi}_2\text{O}_3 + 2\text{TiO}_2 + 3\text{Nb}_2\text{O}_5 + 40\text{P}_2\text{O}_5$ is best for shielding 15 keV x-rays and x-rays of energies between 80 keV and 300 keV.

Keywords : bismuth-titanium-phosphate glass, x-ray shielding, LAC, MAC, radiation shielding

Conference Title : ICRHERP 2024 : International Conference on Radiation Health Effects and Radiation Protection

Conference Location : Paris, France

Conference Dates : February 19-20, 2024