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

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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 $45Na_2O + 10 Bi_2O_3 + (5 - x)TiO_2 + (x) Nb_2O_5 + 40 P_2O_5$, were x = 0, 1, 3, 5 mol%, glass materials were studied. The results revealed that the glass sample with the highest TiO2 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 Nb₂O₅ has the highest mass and linear attenuation coefficients and mean-free path at 15 keV and photon energies between 80 to 300 keV. It was, therefore, concluded that $45Na_2O + 10 Bi_2O_3 + 5 TiO_2 + 40 P_2O_5$ glass is best for shielding x-rays of energies between 20 and 80 keV, while $45Na_2O + 10 Bi_2O_3 + 2 TiO_2 + 3 Nb_2O_5 + 40 P_2O_5$ is best for shielding 15 keV x-rays and x-rays of energies between 80 keV and 300 keV.

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

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