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Amorphisation of boron carbide under gamma irradiation

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Abstract

Boron carbide (\(\hbox {B}_{\mathrm {4}}\hbox {C}\)) has been widely used in nuclear reactors and nuclear applications. In this work, the high-purity (99.9%) \(\hbox {B}_{\mathrm {4}}\hbox {C}\) samples were irradiated using a gamma source (\(^{\mathrm {60}}\hbox {Co}\)) with a dose rate (*D*) of 0.27 Gy/s at different gamma irradiation doses at room temperature. Phase and microstructural characterisation of \(\hbox {B}_{\mathrm {4}}\hbox {C}\) samples were carried out using X-ray diffraction (XRD) and scanning electron microscopy (SEM). XRD results displayed some degradation of the diffraction peaks. The calculations reveal that 62% of \(\hbox {B}_{\mathrm {4}}\hbox {C}\) has changed into the amorphous phase when the irradiation dose is 194.4 kGy. Fourier transform infrared spectroscopy (FTIR) was used to explain

chemical bonds and functional groups of \(\hbox {B}_{\mathrm {4}}\hbox {C}\) samples before and after gamma irradiation. The results showed that C–C chemical bonds are weaker than B–C chemical bonds and tend to break under gamma irradiation. Element mapping analysis for each gamma irradiation dose of \(\hbox {B}_{\mathrm {4}}\hbox {C}\) samples was performed using SEM patterns. The dynamics of the elements on the surface and chemical formula of all \(\hbox {B}_{\mathrm {4}}\hbox {C}\) samples were also determined after gamma irradiation.