

Effect of Thermal Treatment on the Structure and Morphology of BiSI Pellets for Radiation Detector Applications

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There are various technological approaches for the fabrication of radiation detectors. While single crystals offer excellent properties, their growth is challenging for certain compounds, and more importantly, demand a lot of time and energy. As an alternative, pellet-based detectors are a more accessible, robust, and scalable option that is gaining attention[ref nature]. This research focuses on pellets based on a nanocomposite of BiSI and amorphous carbon:. Previous research conducted by our group has shown that BiSI can detect low energy gamma and X-ray radiation, and the inclusion of amorphous carbon in the starting material and thermal treatment enhances device performance [2]. To optimize the pellet fabrication process, and eventually the device performance, different BiSI-to-carbon ratios were evaluated, along with thermal treatments applied both during pressing (in situ) and after pressing (ex situ).

Both the starting materials and the pellets were characterized by powder X-ray diffraction (XRD), confirming the formation of a single BiSI phase, which remains stable after both in situ and ex situ thermal treatments. Scanning electron microscopy (SEM) revealed that the initial powder consists of nanorods with an average size of 300 nm, and amorphous carbon particles with an average diameter of 5.7 μm . In pellets subjected to in situ thermal treatment, sintering of nanorods on the surface was observed, along with the coalescence of amorphous carbon particles both inside and on the surface of the pellet. In contrast, ex situ treated pellets showed no evidence of sintering on the surface or in the interior for either material. The upcoming phase of this research will be dedicated to the development of prototype radiation detectors. These will be subjected to thorough electrical characterization to explore their potential for future technological applications.

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References

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