Abstract

Nonvolatile memory is becoming increasingly important due to its advantages of power saving in personal computers and other devices and its ability to speed up the processing of large amounts of data in memory. Two-dimensional (2D) materials offer exceptional electrical and optical properties, making them promising candidates for Nonvolatile memory applications. Among the group of 2D materials, α-In_2Se_3 stands out for its unique characteristics, making it a subject of extensive study. The properties of layered materials like α- In_2Se_3 are intricately tied to their structure, with different polytypes influencing their behavior. Understanding and identifying the structural properties of these materials is crucial for utilizing their full potential.

In this research, we investigated the crystal structure and morphology of thick α- In_2Se_3 flakes containing approximately 100 layers. The motivation behind this study lies in the need to unravel the intricate details of these materials, particularly for their potential applications in nonlinear optics.

We employed multiple characterization techniques, including Second Harmonic Generation (SHG), Transmission Electron Microscopy (TEM), and Raman spectroscopy to achieve a thorough analysis. SHG measurements revealed the presence of both out-of-plane and in-plane signals, pointing to the non-centrosymmetric nature of α- In_2Se_3, stemming from its hexagonal stacking. This observation is crucial as it signifies the material's suitability as a platform for nonlinear optics applications.

Transmission Electron Microscopy provided detailed insights into the morphology of the thick α-In_2Se_3 flakes, allowing us to confirm the hexagonal characteristic of α- In_2Se_3. This structural information is vital for understanding the material's behavior and properties.

Raman spectroscopy played a pivotal role in our investigation, providing valuable data on the vibrational modes of α- In_2Se_3. The results obtained from Raman spectroscopy complemented the findings from SHG and TEM, offering a comprehensive view of the material's crystal structure.

Our research highlights the significance of studying the structure of thick α- In_2Se_3 flakes for their potential applications in nonlinear optics. The combination of SHG, TEM, and Raman spectroscopy allowed us to elucidate the crystal structure and morphology of these materials, paving the way for their effective utilization in emerging technological applications.

Keywords: Two-dimensional, α- In_2Se_3, SHG, TEM, Raman Spectroscopy.