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Study Of Optically Transparent Objects By Spectrospic Methods

Raimov Gayrat Fayzullayevich, Mirzamuratov Baxodir Fayzullayevich

Head teacher, Termez State University

Annotation: The isotope Sn^{119} was introduced into the As_2Se_3 compound, which is optically transparent and crystalline, and the charged state of the compound atom was determined using Messbauer spectroscopy.

Keywords: amorphous, optical rays, nuclear gamma resonance, Messbauer spectroscopy, isotope, quartz, transparent, As_2Se_3: Sn compound.

Nuclear gamma-resonance spectroscopy (Messbauer effect) is used to study the structural and optical properties of materials that have an amorphous structure but are capable of transmitting optical rays.

The As_2 Se_3 compound under study is called a binary compound, and they are formed from the combination of only two chemical elements. To study this type of binary compound using Messbauer spectroscopy, the 119-Sn isotope was synthesized into the compound. Although the 119-Sn isotope included in the compound is 0.1%, its atoms are located in different positions in the binary compound. First, the required amount of As and Se elements is taken and placed in a quartz ampoule. A 0.1% 119- Sn isotope is also added and the air inside the quartz ampoule is sucked in and the ends are hermetically sealed. The ampoule was then heated in an electric oven at a temperature of 1050 ° C and the electrons inside were illuminated and mixed. After 2 hours of synthesis, this ampoule was immersed in 0 ° C water (icy water). The high-temperature binary compound in the ampoule cools very rapidly when immersed in icy water and forms the As_2Se_3: Sn compound, which is optically transparent and has an amorphous structure.

For the study of this compound on the Messbauer spectrometer, the compound was pulverized into a powder and converted into a tablet suitable for use in the Messbauer spectrometer on a special device. This tablet was used as a gamma light absorber on the Messbauer spectrometer.

The Sn atoms in the As_2Se_3: Sn compound replace the atoms in the lattice nodes in the structure, and therefore it is possible to study the properties of the As and Se atoms in the structure based on the study of the properties of the Sn compound atoms.

The results obtained using Messbauer spectroscopy showed that the Sn atoms embedded in the glassy As_2Se_3 material were found to be present in the new Sn + 2 state when they were not electrically active. The Messbauer spectrum for atoms in the Sn + 2 state in the As2Se3 compound is shown in Picture 1. If the glassy As_2Se_3 compound is heated again to 1050℃ and then cooled very slowly, the crystal structure of the As_2Se_3: Sn compound is formed. When such a crystalline structural As_2Se_3: Sn compound was studied using Messbauer spectroscopy, it was found that the Sn atoms in this compound were present in the structure in the Sn + 4 state. In this case, the Sn atoms are electrically active and the electrical conductivity of the crystal is much higher.

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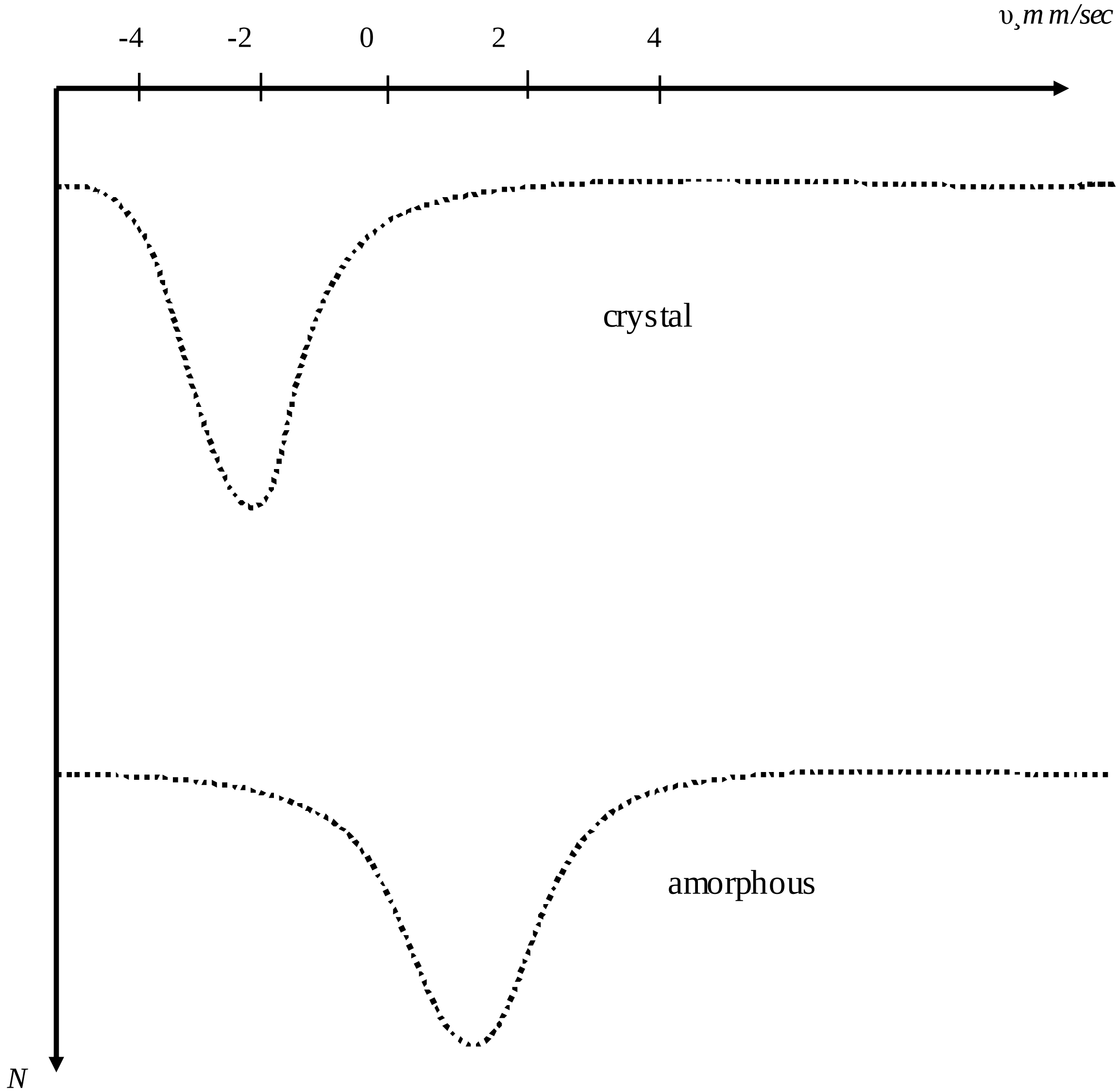
Picture 1.

Messbauer spectra of As_2Se_3: Sn^{119} in the crystalline and amorphous state



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