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شبكة المعلومات الجامعية
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شبكة المعلومات الجامعية التوثيق الالكتروني والميكروفيلم



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٤٥٢٠



South Valley University
Faculty of Science (Aswan)

CRYSTAL GROWTH AND STUDIES OF SOME TERNARY SEMICONDUCTOR COMPOUNDS

A THESIS

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

« عَلَّمَ الْقُرْآنَ خَلَقَ الْإِنْسَانَ مِنْ عَلَقٍ نَعَلَّمَ

حُسْنَ الْوُجُوهِ عَلَّمَ الْبَشِيرَ وَالْعَظِيمَ

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CHAPTER (1)

Introduction

(1-1) GENERAL INTRODUCTION.

We can broadly classify the solid state materials into two categories with respect to structure [1]:

One of them is called crystalline solids, with atomic building blocks occur more or less in regular pattern, and the other category is called amorphous solids in which there is no definite microscopic pattern to the atom arrays. As the electricity was discovered, it was found that there are two groups of solid state materials with respect to electrical conduction: good conductors (metals) with electrical conductivity between 10^4 to 10^6 $(\Omega \text{ cm})^{-1}$, and insulators (non metal) that have electrical conductivity less than 10^{-10} $(\Omega \text{ cm})^{-1}$. But it was found that there is another group of some solids has an electrical conductivity lies between 10^{-10} to 10^4 $(\Omega \text{ cm})^{-1}$. This last group was classified as semiconductor materials. Semiconduction can be specified as following [1]:

- i. In pure semiconductors, electrical conductivity rises exponentially with temperature. At lower temperature a smaller concentration of impurities is required in order to ensure this behavior.
- ii. In impure semiconductors, electrical conductivity depends strongly on the impurity concentration.
- iii. The electrical conductivity in semiconducting materials changes (general rises) by irradiation with low or high-energy radiation or by injection of carriers from a suitable metallic contact. It also depends on the kind of doping, where the charge transport may be either by electrons or by so-called positive holes. These two kinds give two different kinds of the electrical behavior.

These semiconducting materials have been applied in the electrical technology to provide devices with non-linear current-voltage characteristics, also the sensitive elements in photocell [2].

The intensive work was not started on the industrial applications of semiconductors until the beginning of the forties [3]. In fifties there is a class of semiconductor devices were constructed such as tunnel diodes, field-effect transistors, thyristors and many others. At the beginning of the sixties, the planar epitaxial technology came into practice which enabled serial production of high-frequency diodes and transistors with a narrow spread of parameters, high stability, and broad range of operating powers acting up to hundred of watts. This technology allowed for the production of complete radio circuits with hundreds of components grown from single crystal semiconductors.

Now the development of the solid state technology has rapid introduction of the scientific achievements into practice, for example the semiconductor devices formed the bases of modern radio-electronics and found extensive applications in computing technique, electrical engineering and various industries directly associated with the conservation of electrical energy.

(1-2) The previous works and the crystal structure of TlGaSe_2 single crystal.

The Thallium chalcogenides TlBX_2 ($\text{B} = \text{Al}, \text{Ga}$; $\text{X} = \text{S}, \text{Se}, \text{Te}$) are comparatively new group of compounds in this general class are of interest because of their layered structure [4].

The melting point and the density of TlGaSe_2 were determined according to the electrical measurements by G.D. Guselnov. The TlGaSe_2 compound ranks among the new incompletely valent ternary layer-and-chain semiconductor [5].

An investigation of T-P phase diagram of TlGaSe_2 crystal between room temperature and 520K under hydrostatic pressure up to 1.2 GPa was made by K. R. Allakhverdiev et al. [6]. P-type TlGaSe_2