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Optical Characterization of in Te:Bi Crystal

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Abstract: Technology for the crystal growth of ternary alloys of III-V compounds is usable in the field of IR detection. Photo detectors used in military, medical diagnosis and pollution monitoring devicesoperate in wave length range from 8 to 12 µm. The methods of crystal growth from melt like zone melting and Bridgman have been widely used for such intermetallic. The authors have usedBridgmanmethod because of the steady state growth obtainable with it. EDAX has been used for confirmation of constituent elements ofInTe:Bi. To obtain the band gap FTIR was used for IR Region.

Keyword: S*ingle crystal, Growth from melt, Band gap*

I. INTRODUCTION

In the recent year semiconductor technology has shown interest to grow ternary material of III-IV compound in the field of IR detection.(1-4)Ternary III-IV materials like InSb:Bi, InAs:Bi, InBi:Se etc. had been consider for the same. The photo detectors operating with low wave length used in military, medical diagnosis, pollution monitoring device etc.(5) Bismuth telluride and its alloys are widely used as materials for thermoelectric refrigeration.(6) It has been used in thermoelectric refrigerators for the temperature control of semiconductor devices such as laser diodes or CCDs (charge coupled devices).

II. EXPERIMENTAL PROCEDURE

Bridgmen method is the simple method forcrystalgrowth from meld.A quartz ampoule with material which had 10^{-4} Pa pressure was sealed &inserted for melting & stirring the charge. The rotation the quartz tube gives stirring effect to the molten charge.

For thorough mixing of the charge, this treatment was continued for 2 to 3 days. The molten was then slowly cooled to room temperature .The ampoule was kept steady for 24 hours in the upper hot zone of the furnace and then lowered into the cold zone at a rate of 0.35 cm/hr and through a temperature gradient of about 45ºC/cm. The crystal was obtained 3.5 cm in length and 1.2 cm in diameter. They could be cleaved easily.

III. RESULT AND DISCUSSION

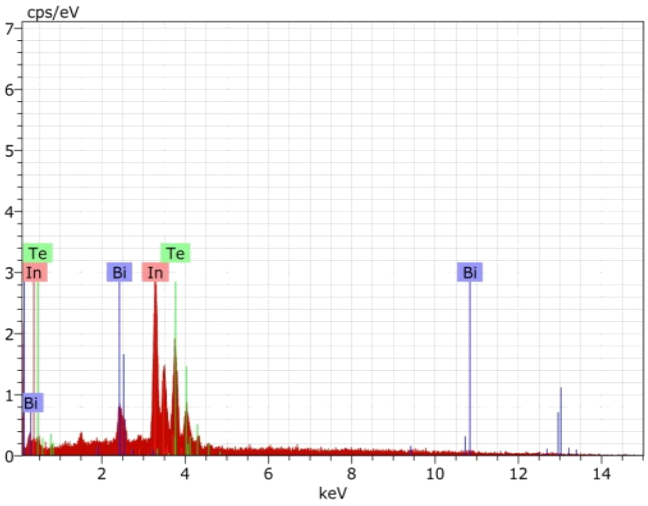


Fig 1

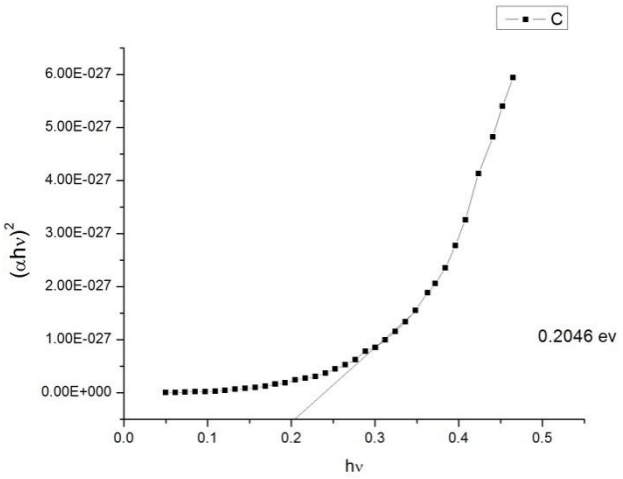
Fig 2

Table 1

Element	Series	[at.%]

Indium	L-series	55.63
Tellurium	L-series	38.93
Bismuth	M-series	5.44

Surface of InBI:Tecrystal shown in Fig.2 Concentration distribution of Te was determind by the X-ray energy dispersive spectroscopy(EDAX)which shown in Fig 2. The optical absorbance was measured by FTIR in the range from 400 to 4000cm-1the absorption co-efficent α (hυ-Eg).where hυis the incident photon energy.(7-8)The plots of $(\alpha h\upsilon)^2$ vshυwere used to evaluate the optical band gaps.The plots are observed to be linear in the region of strong absorption near the fundamental absorption edge. Hence by extrapolating the linear portion to zero, the band gap was evaluated.The valued of the band gap is obtained 0 .2046



CONCLUSION

1. The Bridgman method is very useful to grow InTe: Bi
2. There are layer growth mechanism has happend
3. EDAX analysis shows that the growth of crystals are stoichiometric and homogenous.
4. The band gap ofInTe:Bi is 0.20ev There are no observable indirect transitions in the crystals.

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