IOSR Journal Of Applied Physics (IOSR-JAP)
e-ISSN: 2278-4861.Volume 12, Issue 2 Ser. I (Mar. – Apr. 2020), PP 30-34
www.Iosrjournals.Org

Evaluation of Optical Traits of Urea Doped Thiourea Zinc Sulphate (U-ZTS) Metal Complex Crystal for NLO Applications

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Abstract: *Present research work focuses on evaluation of the impact of urea doping on thiourea zinc sulphate metal complex crystal (ZTS).Traditional slow evaporation solution growth technique was preferred at ambient temperature for the growth of Urea doped thiourea zinc sulphate (U-ZTS) metal complex crystal. This investigation deals with the study of optical properties transmittance, band gap, refractive index, reflectance, extinction coefficient of Urea doped thiourea zinc sulphate (U-ZTS) metal complex crystal. Kurtz-Perry SHG test pointed the nonlinearity of Urea doped thiourea zinc sulphate (U-ZTS) metal complex crystal.*

Keywords: *Crystal growth, Urea, Thiourea Zinc Sulphate Kurtz-Perry SHG test, extinction coefficient*

Date of Submission: 03-03-2020 Date of Acceptance: 18-03-2020

I. Introduction

Non linear optical (NLO) materials have attracted much attention due to their major role in emerging photonic and optoelectronic technology **[1-2]**. The recent search in concentrated on organo-metallic NLO materials due to remixing of large non linearity, high resistance to laser induced damage with good mechanical hardness **[3-4].** The NLO properties of some complexes of thiourea have attracted significant attention in the last few years because both organic and inorganic compound in it contribute specifically to the process of second harmonic generation **[5-7]**. Examples of these complexes are Bis thiourea zinc acetate (BTZA) **[8]** and cadmium thiourea acetate (CTA) **[9]**. Urea thiourea mercuric sulphate and Urea thiouyrea mercuric chloride have been already reported. Nonlinear optical (NLO) material Zinc tris (thiourea) sulphate (ZTS) is a best alternative for potassium dihydrogen phosphate crystals in frequency-doubling and laser fusion due to their properties high optical transparency, low refractive index, low reflectance low extinction coefficient, widened band gap, Second harmonic generation efficiency 1.2 times that of KDP, growth from solution by slow evaporation **[10-20]**. Urea thiourea mercuric sulphate and urea thiourea mercuric chloride **[21]**, Urea thiourea copper have been already reported **[22]**. In the present investigation attempt have been made to grow optical clear crystal of ZTS doped 0.3M% urea **(U-ZTS)** by slow evaporation technique.

II. Experimental Procedure

Zinc Thiourea Sulphate (ZTS) salt was synthesized using AR grade zinc sulphate and thiourea in 1:3 molar concentration. Prepared salt was further purified by repeated crystallizations. The calculated amount of salt was dissolved in the deionized water to achieve the super saturated solution. 0.3M% urea was doped to the super saturated solution of ZTS and Stirred for 5 hours at constant speed to achieve homogeneity throughout the volume. The purity of 0.3M% urea doped ZTS **(U-ZTS)** is achieved by successive recrystalization. Good quality crystals were grown over period of 30 days. The grown crystal of **U-ZTS** is shown in **Fig 1**.

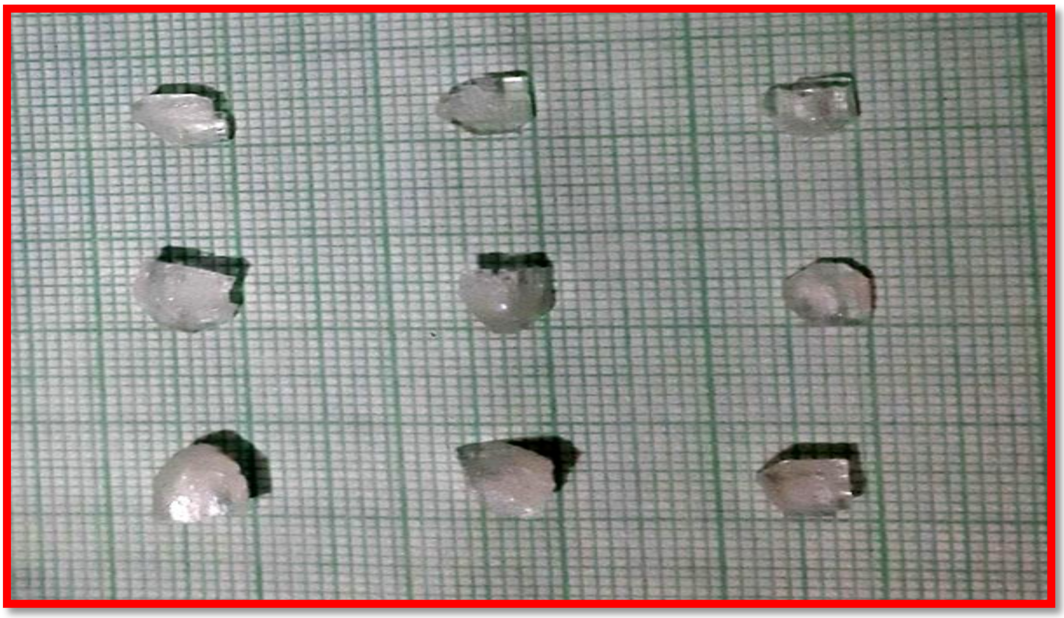

Fig.1. ZTS Doped 0.3M % Urea Crystals.

III. Results And Discussion

3.1 Optical Study

3.3.1 UV Visible Study

UV-Visible study of 0.3M% urea doped ZTS crystal **(U-ZTS)** was investigated using Shimadzu UV-2450 spectrophotometer in the range to 200-900 nm to ascertain the optical transmittance of crystal and plotted in **Fig. 2.** shows a maximum transmittance 80% in visible region. The enhancement in optical transmittance may be attributed due to a reduced scattering effect **[23].**

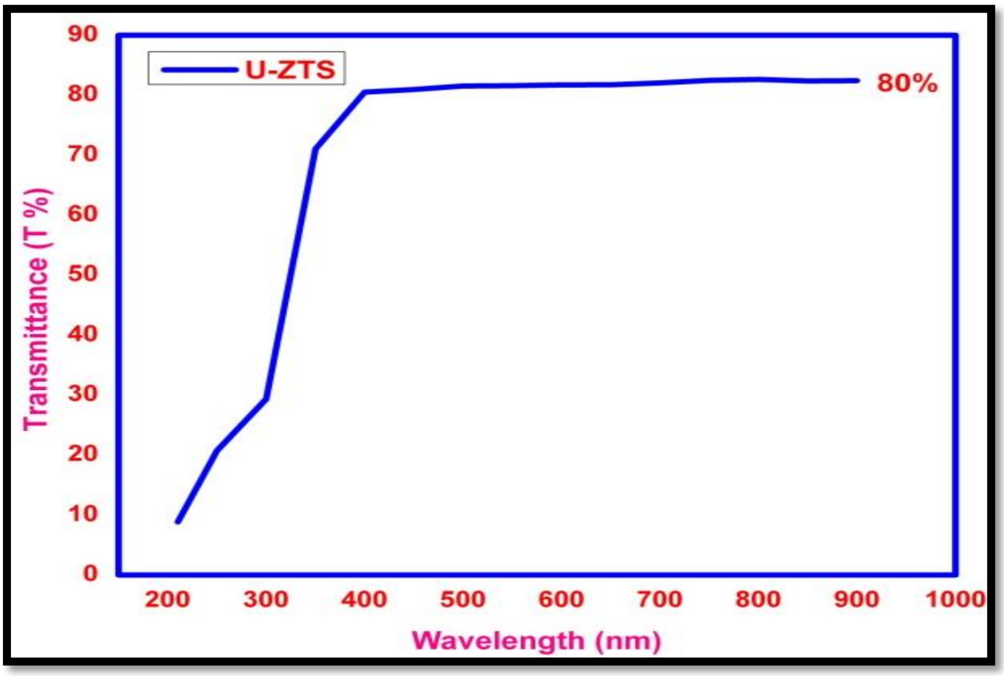

Fig.2. Transmittance Curve

3.3.2 BAND GAP

The transitory nature of electrons in presence of optical field serves the evidence for energy band gap obeying the relation given as $\alpha=A(\hbar\nu-E_g)^{1/2.}$ Here $\hbar\nu$ is photon energy and E_g energy band gap. Tauc's Plot depicts optical band gap shown in **Fig.3.** the optical band gap of 0.3M% urea ZTS crystal **(U-ZTS)** is 4.4 eV. The lower absorption and high optical band gap is most desirable for UV tunable laser materials.

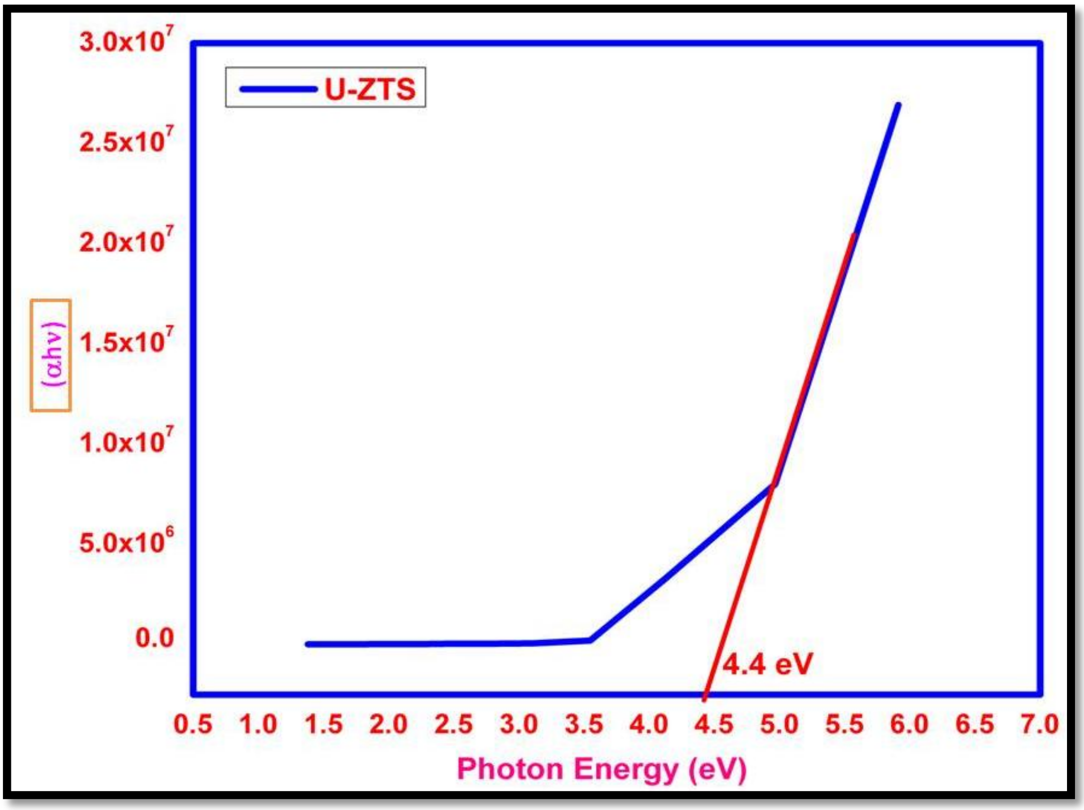

Fig.3. Tauc's Plot of Band gap

3.3.3 Linear optical Constants

The transmittance data was used to determine the linear optical constants. The variation of refractive index, extinction coefficient and reflectance is shown in **Fig.4, Fig.5 and Fig.6** respectively. The determined refractive index 1.65 was calculated using formula reported by Bakr et al. The obtained optical constants of U-ZTS crystal viz. lower reflectance; lower extinction coefficient confirms suitability for coating applications, optical fabrication field and for calibration **[23-27]**.

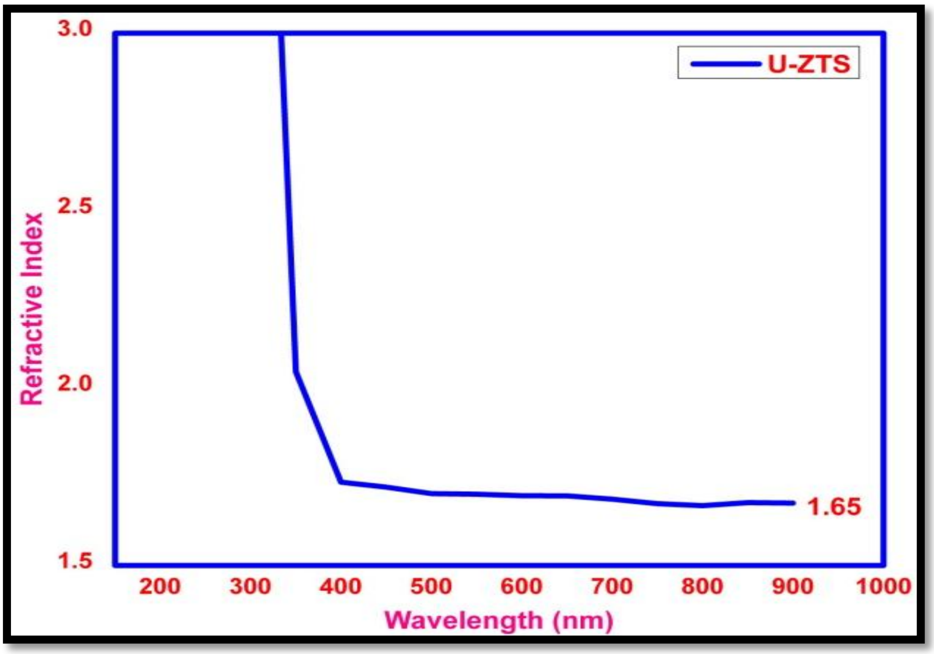

Fig.4. Refractive Index

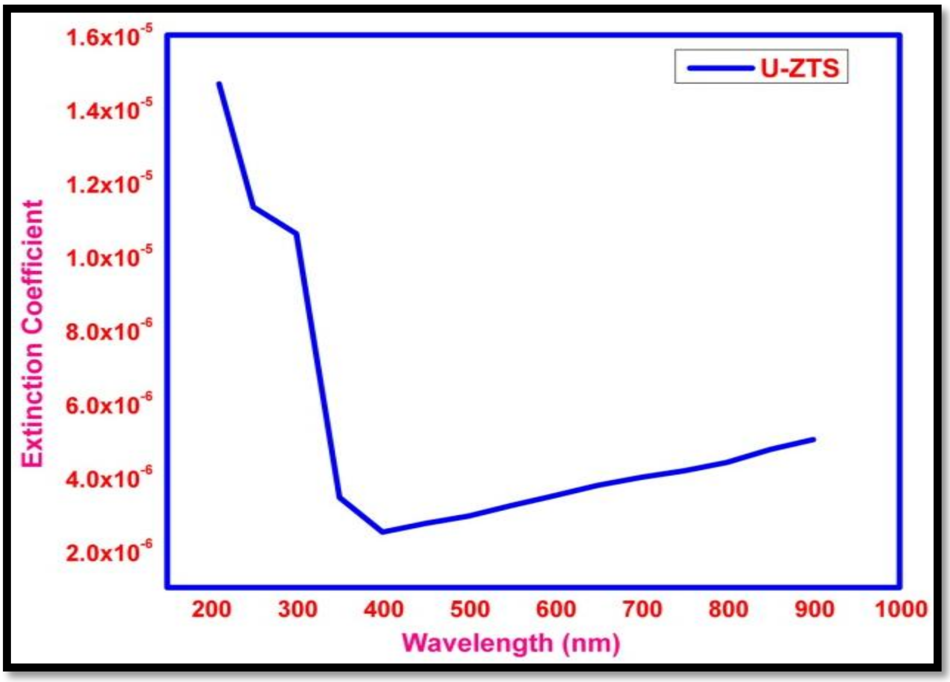

Fig.5. Extinction coefficient

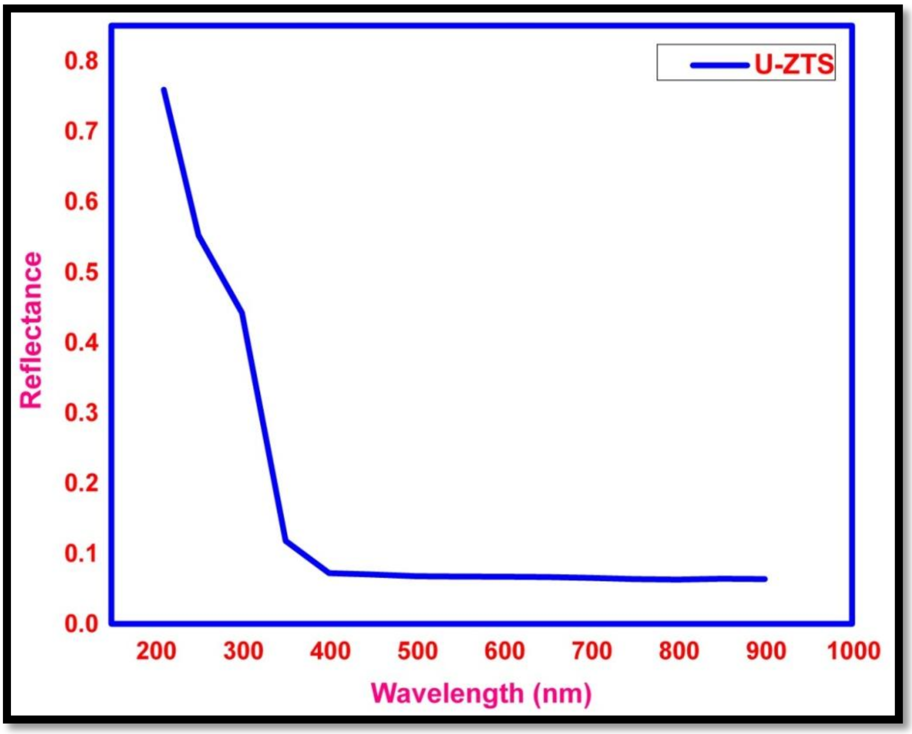

Fig.6. Reflectance

IV. Conclusions

Optical quality single crystal of 0.3M% Urea doped ZTS was grown by slow solution evaporation technique. The optical studies shows that 80% higher and wider transmission, lower cut-off , widened band gap 4.4 eV and lower values of extinction coefficient, reflectance, and refractive index of 0.3M% Urea Doped ZTS crystal **(U-ZTS)** substantiates its suitability for optical device fabrication, laser and NLO applications.

References

[1]. H.O. Marey , L.F.Warrn , M.S Webb, C.A Ebbers, S.P. Velsko, G.C. Kennedy and G.C.Catella, Apllied Opts.,31 **(1992)** 5051
[2]. X.O.Wange , D.Xu, D.R. Yuan, Y.P.Tian, W.T.Yu, S.V.Sun, A.H. Yang, Q.Fang, M.K.Lu, Y.X. Yan, F.Q.Meng, S.Y.Guo, G.H. Zhang and M.H.Jiang, Mater.Res.Bull.,34 **(1999).**
[3]. L.F. Warren, R.E. Allred, R.J. Martinez, K.B. Wischmann. Proceeding of the Fourth International Sample Electronics Conference. Society for the Advancement of Material and Process Engineering, Convia, CA, 4**(1990)**338-396.
[4]. T.Y. Change, D.E. Copper, G.L. Burdge, P. Polak, C.K.Lowe-Ma, C.Y. Chiange, P.M. Chaikan, Cowan DO (Eds), Advanced organic Solid State Materials, Materials Research Society Symposium Proceedings, Materials Research Society, Pittsburg, PA,173**(1990)** 557.
[5]. H.O. Mercy, L.F. Warren, M.S. Webb, C.A. Ebbers, S.P. Velsco, G.C. Kennedy, G.C. Catella, Appl. Opt,. 31**(1992)**5051.
[6]. V.Venkataramanan, S.Maheswaran, J.N. Sherwood, H.L.Bhat, J.Cryst. Growth, 179 **(1997)**605.
[7]. V.Venkatramanan, G.Dhanraj, V.K. Wadhawan, J.N. Sherwood, H.L. Bhat, J.Cryst. Growth, 154 (**1995**) 92.
[8]. V.Kannan, N.P. Rajesh, R.Bairava Ganesh, P.Ramasamy, J. Cryst. Growth, 269(**2004**) 565.
[9]. N.P. Rajesh, V.Kannan, M.ashok, K.Shivaji, P.Santhana raghavan, P.Ramasamy, J.Cryst. Growth, 202 (**2004**)561.
[10]. Kanganapathy, G.Gowri, Indian J. of pure and applied physics, 54**(2016)**193-198.
[11]. Sweta Moitra, Tanusree Kar , Optical Materials, 30**(2007)** 508–512.
[12]. S. Moitra , S. Bhattacharya , T. Kar, A. Ghosh , Physica B, 403**(2008)**3244-3247.
[13]. T. C. Sabari Girisun,and S. Dhanuskodi, Cryst. Res. Technol., 44**(2009)**1297-1302.
[14]. J. Felicita Vimala, J. Thomas Joseph Prakash, Elixir Crystal Growth, 56 **(2013)**13350-13354.
[15]. Kiran T. Rathod, I.B. Patel, C.F. Desai, Y.H. Gandhi, Inter. J. of Luminescence and Applications, 5**(2015)**86-88.
[16]. S. K. Kushwaha, K. K. Maurya, D. Haranath and G. Bhagavannarayana, J. Appl. Cryst., 44**(2011)**1054–1061.
[17]. C. Krishnan and P. Selvarajan, Journal of Experimental Sciences, 1**(2010)**23-26.
[18]. Sonia Bhandari , Nidhi Sinha , Geeta Ray , Binay Kumar, Chemical Physics Letters, 591 **(2014)**10-15.
[19]. V.N. Praveena, N.Vijayan, C.K.Mahadevan, Optik, 123**(2012)**1617.
[20]. Sunil Verma, M.K.Singh,V.K.Wadhawan,C.H.Suresh,Pramana,Indian Academy of Sciences, 54**(2000)**879-888.
[21]. S.Gunasekaran, G.Anand, R.Arun balaji, J.Dhanalakshmi and S.Kumaresan, Pramana jaournal of Physics, 75(**2010**) 683-690
[22]. S.Sivasankaran. S. Ilangovan, S.Arivoli , International fournal of Innovative Research in Science, engineering and Technology, 6**(2017)**.
[23]. M.S. Pandian, P. Ramasamy, J. Cryst. Growth, 312**(2010)**413-419.
[24]. G. Ramesh Kumar,S. Gokul Raj,R. Mohan, R. Jayavel, Crystal Growth and Design,6**(2006)**1308-1310.
[25]. M. Shkir, S. Muhammad, S. AlFaify,Spectrochem. Acta A, 143**(2015)** 128-135.
[26]. Rupali B. Kulkarni, Mohd Anis, S. S. Hussaini and Mahendra D. Shirsat, Modern Physics Letters B, 32**(2018)**1850424. **DOI: 10.1142/S0217984918504249**
[27]. Y B Rasal, R N Shaikh, M D Shirsat, S Kalainathan and S S Hussaini, Mater. Res. Express 4 **(2017)** 036202.

S. S. Hussaini,et al. “Evaluation of Optical Traits of Urea Doped Thiourea Zinc Sulphate (U-ZTS) Metal Complex Crystal for NLO Applications.” *IOSR Journal of Applied Physics (IOSR-JAP)*, 12(2), 2020, pp. 30-34.