International Journal of Scientific Research in Science and Technology
Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)
doi : https://doi.org/10.32628/IJSRST207464

Characterization of Glassy TeO_2 and Binary Potassium and Boron Tellurites

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Article Info
Volume 7, Issue 4
Page Number: 283-286
Publication Issue :
July-August-2020

Article History
Accepted : 15 Aug 2020
Published : 25 Aug 2020

ABSTRACT

Tellurite glasses show potential for use in mid-infrared optical applications1, yet their structure has not been seriously contemplated. While they don't lead light better than chalcogenides, which are as of now the best glasses for infrared optics, they are a lot simpler to create. Potassium and boron tellurite glasses, including single part, quickly cooled TeO2, are accounted for and concentrated here. The outcomes incorporate the Glass Transition Temperature (Tg) estimations and Raman spectra. Proposed auxiliary models are additionally examined.

Keywords : Glass Structure, Glass Transition Temperature, Raman Spectroscopy, Tellurites

I. INTRODUCTION

Tellurium dioxide (TeO2) is a contingent glass previous and the use of fast cooling through the twin roller method has empowered glass arrangement partly. Alteration of tellurium byboron oxide and potassium oxide brings about a lot simpler glass development with more slow cooling rates, and subsequently, produces higher glass yield.

In this paper we report on physical properties and structure of these tellurite glasses, remembering estimations for single stage TeO2 glass. The physical properties estimated were the glass change temperature (Tg) and the crystallization temperature (Tx). Raman spectroscopy was utilized to derive basic data.

Most glass framing oxides have a coordination number that is an entire number and a smooth structure that is like the comparing translucent structure. Initially, it was accepted that tellurium dioxide likewise followed this pattern, yet as indicated by neutron dissipating and Raman spectroscopy, that doesn't appear to be the case.1 Instead of the unadulterated glass comprising of just four facilitated units (where the tellurium is clung to four oxygen iotas), it additionally incorporates three composed units (where the tellurium is attached to three oxygen), as appeared in Figure 1. No doubt, the unadulterated TeO2 glass structures in around 66% four facilitated units and 33% three composed units with a twofold reinforced oxygen, because of an expansive conveyance of Te-O security lengths and deviated securities.

II. EXPERIMENTAL PROCEDURE

2.1 Glass Preparation

The glasses were produced using reagent evaluation or better tellurium dioxide, boric corrosive, and potassium carbonate. The boron tellurites, potassium tellurites, and unadulterated TeO_2 glasses were made in 4 to 10 gram all around blended groups. The bunches were warmed at 800 oC for 10 minutes, after which a weight reduction was resolved, and the glass was warmed at a similar temperature for an additional 10 minutes, so, all in all the examples were extinguished into glasses as portrayed underneath.

All examples were made and warmed in platinum pots. Glasses were roller quenched2, which created clear yellow or orange colored glasses, likely because of modest quantities of platinum sullying in the ppm go. The cooling rate was around 500,000 ± 100,000 ^{o}C/s.

2.2 Thermal Measurements

Warm estimations utilizing differential filtering calorimetry (DSC) were performed by warming from room temperature at 40 oC/min to 400 oC utilizing a TA model Q200 Differential Scanning Calorimeter. The beginning strategy was utilized to decide the Tg. A benchmark was run before each estimation and the instrument was adjusted every now and again. The blunder in the announced Tg is roughly ± 3 °C.

2.3 Raman Measurements

Raman spectroscopy was run utilizing a JASCO NRS-3100 Laser Raman Spectrophotometer with a 785 nm laser, utilizing a silicon gem reference for adjustment at 520.52 cm-1. The example was engaged utilizing a 5x, 20x, and 50x focal point progressively and the force of the laser was streamlined to limit commotion. Two 30 second runs were found the middle value of to kill astronomical beam occasions.

III. RESULTS

Table 1 records all Tg and Tx results acquired from DSC estimations. Tg results from unadulterated indistinct TeO_2 were readied utilizing roller extinguishing. The Tg was demonstrated to be 305 ± 3°C, reliable with patterns/extrapolations from different groups of doped tellurium glasses that have been considered and with an ongoing report from the Kamitsos bunch by Tagiara et al.

Raman spectroscopic outcomes from unadulterated TeO_2 and boron tellurites were gotten to check polish and to decide structure. This was accomplished for 3, 2, 1, 0.5, and 0.25-mol % B_2O_3. To see whether the measure of modifier changed the structure of the glass, Raman spectra were analyzed for the doped examples and the unadulterated TeO_2 test. Spectra from the unadulterated TeO_2 glass were contrasted with that of 0.25-mol % B_2O_3 also. No discernable distinction was seen between them; all were smooth, which shows unadulterated TeO_2 glass and the alpha stage TeO_2 precious stone. The tops in the range from the gem are sharp and restricted, which we would expect, and the tops from the glass are more extensive because of the cluttered idea of the indistinct example. Table – 1: Glass change and crystallization temperature results from tellurites concentrated in this paper. All outcomes were gotten from DSC estimations.

Sample	Tg ± 3 °C	Tx ± 3 °C
Pure TeO2 (yellow)	306	349
	308	347
Pure TeO2 (orange)	311	326
$0.03K_2O$-$0.97TeO_2$	303	304
	303	333
	301	344
$0.02K_2O$-$0.98TeO_2$	303	338
	301	340
	302	334
$0.01K_2O$-$0.99TeO_2$	305	324
	304	324
	303	331
$0.03B_2O_3$-$0.97TeO_2$	316	357
	313	353
	314	360
	312	350
$0.02B_2O_3$-$0.98TeO_2$	312	361
	311	360
$0.01B_2O_3$-$0.99TeO_2$	309	341
	310	347
$0.005B_2O_3$-$0.995TeO_2$	308	342
	306	336

The Tgs and Txs of boron tellurites with 3, 2, 1, 0.5, and 0 - mol % B_2O_3. By applying a direct fit to the extrapolated information, the Tg and Tx of unadulterated nebulous TeO2 were evaluated to be around 306 °C and 340 °C, individually. The Tg extrapolated was inside blunder of the deliberate TeO_2 Tg of 305 ± 3 °C, while the Tx was somewhat farther away from 348 ±3 °C. The Tg and Tx are genuinely close, implying that extremely high cooling rates should be gone after glass arrangement.

IV. CONCLUSION

While it is conceivable to create modest quantities of unadulterated TeO2 glass through the roller quencher, it's anything but an attainable technique for huge scope manufacture. Rather, a water extinguishing procedure has been utilized to make 0.6 to as much as 3 gram tests. This bigger example size will take into consideration a more noteworthy assortment of basic tests to be run.

DSC results for unadulterated TeO2 place the Tg at roughly 305 °C, which is steady with the extrapolation of patterns from the groups of borate, potassium, and barium tellurites and other writing esteems. Notwithstanding warm estimations, coordination quantities of TeO2 for the barium and strontium tellurite frameworks were determined utilizing Raman information (excluded from this paper). The barium tellurites show a diminishing pattern in Te coordination as the modifier is included, which is accepted to happen in light of the fact that the expansion in barium content includes non-connecting oxygen's in the tellurite framework. The strontium tellurite framework shows a comparable conduct. The most fascinating outcome to see, notwithstanding, is that a large portion of the patterns of the two families highlight the coordination number of unadulterated TeO2 being roughly 3.7, which is reliable from values found in the writing. Taking a gander at the coordination number of unadulterated SiO2 glass, which is 4, this could clarify why unadulterated tellurium glass is so hard to deliver. Rather than having a significantly number of also measured bonds, as in SiO2, TeO2 doubtlessly has bonds that are deviated long, accordingly making a strong short-go request more enthusiastically to accomplish.

One potential course to more readily contemplate the indistinct TeO2 structure is to utilize the gamma stage gem, as fundamental work recommends it coordinates the structure of the glass superior to the alpha stage precious stone. For additional investigation of this, gamma stage gem must be delivered by heat-treating little examples of unadulterated TeO2 glass, as those are where this precious stone has been shaped. There are additionally more glasses in the basic earth tellurite families that might be concentrated by roller extinguishing, explicitly the calcium and magnesium frameworks.

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Cite this article as :

Megha, Mansi, "Characterization of Glassy TeO2 and Binary Potassium and Boron Tellurites", International Journal of Scientific Research in Science and Technology (IJSRST), Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 7 Issue 4, pp. 283-286, July-August 2020. Available at doi : https://doi.org/10.32628/IJSRST207464
Journal URL : http://ijsrst.com/IJSRST207464