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Designation: Assistant Professor

Research Areas: Materials Science, Condensed Matter Physics,

Area of Interests: Glasses & Bio active glasses, Magnetic materials, Luminescence studies, Radiation Shielding, Photo-catalysis, Electro Chemistry, Super capacitors, Solar Cells,

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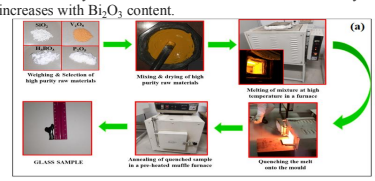
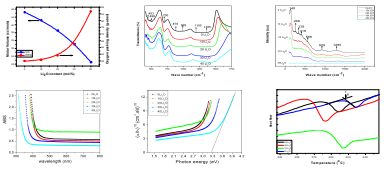
Amorphous Materials (glasses):

- ✓ Many inorganic substances may be formed not only in the crystalline form but also in a glassy state, when their structure lacks the long-range crystallographic order.
- ✓ Some inorganic compounds can be transformed into the glass state by using techniques such as ultra-quick under cooling of the melt to the solid state.
- ✓ Nowadays the chemical composition of the technical glasses can be varied.
- ✓ Almost all of the chemical elements can be used; however, oxide glasses are the most widely used.
- ✓ Glasses have some unique properties which are not found in other engineering materials. The combination of hardness and transparency at room temperature along with sufficient strength and excellent corrosion resistance make glasses indispensible for many practical applications.
- ✓ We prepared $x$$Li_2O$–(40 − x)Bi_2O_3–20CdO–40B_2O_3 glasses by melt quenching technique, the density of the glass samples which is evaluated by Archimedes method showed that the density increases with Bi_2O_3 content.



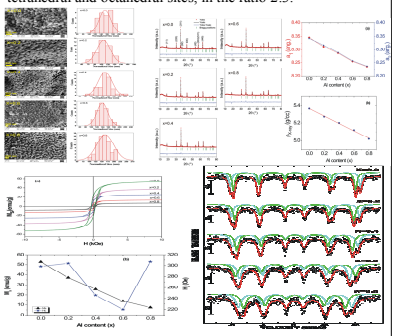
- ✓ The modulated differential scanning calorimetry (MDSC) studies have been done on these samples to evaluate various thermo dynamical parameters. The value of glass transition temperature (T_g) decreases with the Li_2O content.
- ✓ The optical absorption studies revealed that the cutoff wavelength increases while optical band gap energy (E_{opt}) and Urbach energy (ΔE) decreases with increase of Li_2O content and E_{opt} values of these glasses are found to be in the range 2.848–3.258 eV where as the values of ΔE lies in the range 0.21–0.33 eV.
- ✓ Theoretical optical basicity values decreases with Li_2O content.
- ✓ Raman and infrared spectroscopies have been employed to investigate these glasses in order to obtain information about the competitive role of Bi_2O_3 and B_2O_3 in the formation of glass network. IR and Raman spectra show that these glasses are made up of [BO_3], [BO_4] and [BiO_3] pyramidal and [BiO_6] octahedral units. The formation of CdO_4 in tetrahedral co-ordination was not observed.



- ✓ **Reference**: https://doi.org/10.1016/j.optmat.2013.06.013

Magnetic Materials:

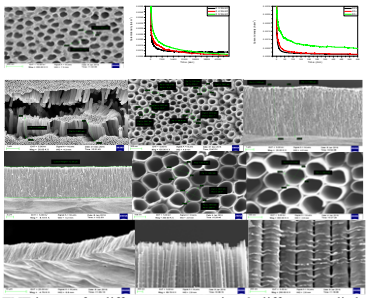
- ✓ The physical properties of nano- ferrites are highly sensitive to various factors such as the method of preparation, synthesis conditions, chemical composition, the type of substituent's and the heat treatment conditions, which further decide the grain size within the formed product and the distribution of cations at the available Th and Oh sites.
- ✓ There are different methods available such as sol-gel auto-combustion, co-precipitation, hydrothermal, high-energy ball milling and micro-emulsion for the synthesis of spinel ferrites.
- ✓ Among these, sol-gel auto combustion method is a simple synthesis technique and advantageous in terms of factors such as low product contamination, economical, homogeneous and stoichiometric product-formation due to high level of reactivity and formation of nanocrystallites.
- ✓ We prepared Al doped $C_{o0.2}N_{i0.8}F_{e2O4}$.nano particles were synthesized by citrate gel auto-combustion method followed by annealing at 1000□°C for 1□h in air. Scanning electron micrographs of all the samples show crystalline particles of irregular morphology with a small variation in particle sizes (~ 110–160□nm).
- ✓ From the analysis of the X-ray diffraction results we observed that the unit cell parameter decreases linearly with increase in aluminium concentration due to the smaller ionic radius of the Al^{3+} ions substituting the other cations such as Co^{2+}, Ni^{2+} and Fe^{3+} ions in the compounds.
- ✓ The room temperature Mössbauer spectra of the samples show Zeeman split sextet patterns corresponding to the tetrahedral (Th) and octahedral (Oh) interstitial iron (Fe^{3+}) cations. The observed magnetic hyperfine field (B_{hf}) decreases with increase in Al-concentration due to the distribution of diamagnetic Al^{3+} in the environment of ^{57}Fe probe atoms.
- ✓ The saturation magnetization measured by Vibrating Sample Magnetometer (VSM) shows a similar trend like that of B_{hf}. The distributions of the cations obtained from the Rietveld refinement and Mössbauer spectroscopy results indicate an increase in Fe^{3+}(Th)/Fe^{3+}(Oh) occupancy-ratio on increasing Al^{3+} concentration, and Ni^{2+} cations prefer the octahedral site, whereas Co^{2+} and Al^{3+} ions redistribute themselves in tetrahedral and octahedral sites, in the ratio 2:3.



- ✓ **Reference**: https://doi.org/10.1016/j.ceramint.2018.08.065

Energy Materials:

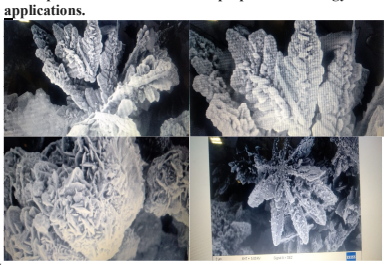
- ✓ Semiconductor has been widely studied in solar energy conversion applications because of its suitable band gap position for photo catalysis, good chemical and thermal durability, and ease of morphological and structural control.
- ✓ Particularly the well-ordered 1D-TiO_2 nanotube (TNT) array provides an electron diffusion channel to transport electrons efficiently along the tube walls with low recombination rates between electrons and holes.
- ✓ Example of light absorption range of TiO_2 is limited to the UV region due to its large band gap energy of ~ 3.2 eV. Thus, in order to achieve effective solar energy conversion applications with a TNT array, the light absorption range needs to be extended. This can be achieved by doping metal/non-metal ions or coupling with visible responsive semiconductors.
- ✓ In our lab we prepared a well ordered Titania Nanotube Membarane (TNT) shown in bellow figures.



TNT images for different concentration & different applied voltages

- ✓ **Reference**: Not published, work carried out in Dr. D. S. Kothari Postdoctoral Fellowship at School of Physics, University of Hyderabad-500046, Telangana.

- ✓ **Other pure Cobalt nano-structes prepared for energy applications.**



- ✓ **Reference**: Not published, work carried out in UGC-Postdoctoral Fellowship at Materials Research Centre, IISc-Bangalore-560012 Karnataka.

Ongoing Projects: UGC Startup grant Project, (No: UGC (No. F.30)-551/2021(BSR) dated 30th November 2021).

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