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Title of the Project:

**SYNTHESIS AND CHARACTEISATION OF NIOBIUM PENTOXIDE NANO
PARTICLES FOR THE FABRICATION OF FUNCTIONAL MATERIALS**

PRINCIPAL INVESTIGATOR

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1. Project Title:

**SYNTHESIS AND CHARACTERISATION OF NIOBIUM PENTOXIDE
NANO PARTICLES FOR THE FABRICATION OF FUNCTIONAL MATERIALS**

2. File No: MRP(S)/13-14/KLKE022/UGC-SWRO

3. Duration: 2 Years

4. Name & Address of PI with mobile No.

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During the period of this study, nano scale composite material with formula Nb_2O_5 was prepared through chemical precipitation method. The structure was analyzed using XRD. Particle size was calculated from XRD using scherrer formula. The structure and morphology of material was analyzed using XRD and the optical band gap of the material was determined from UV-Visible absorption spectra.

The phase purity and crystal structure of Nb_2O_5 nano powders were determined using XRD. The crystallinity of the sample is evidenced by sharp diffraction peaks at respective diffraction angles which can be readily indexed for its orthorhombic structure. By accurately measuring the d-values of (001), (200) and (180) peaks, the obtained values ($a = 6.1364\text{\AA}$, $b = 29.061\text{\AA}$ and $c = 3.894\text{\AA}$) are consistent with the standard JCPDS values ($a = 6.175\text{\AA}$, $b = 29.17\text{\AA}$ and $c = 3.930\text{\AA}$). The calculated crystallite size from the full width at half maximum (FWHM) using Scherer formula for the major (001) plane is ~28 nm.

It is observed that Nb_2O_5 sample absorbs heavily in the UV region, but slightly in the visible region. This is due to the no defects energy states present in the band gap energy region. In semiconductors and wide band gap materials, the absorption coefficient near the fundamental edge depends on the photon energy. It reveals that Nb_2O_5 nanomaterials can readily respond to ultraviolet. Such materials find application in filters and sensors for UV radiation.

On comparing with the PL spectra reported by Zhou et.al, the emission spectra of Nb₂O₅ have two distinct peaks one due to the band edge absorption and other due to the defect levels. In the present study, the ultraviolet emission band at 412 nm is so close to the absorption edge and can be attributed to the near-band gap emission. The lines observed at 412 and 456 nm are due to the transitions 4G_{3.5} - 4G^o_{3.5} and 4F_{2.5} - 4F^o_{2.5} of Nb atom.

Conclusions

- ✓ Nano sized Nb₂O₅ particles are prepared by chemical precipitation method.
- ✓ Structural analysis using XRD confirmed the formation of single phase orthorhombic
- ✓ Structure of the compound and the cell parameters are calculated.
- ✓ Using Scherrer formula, the Particle size of the Nb₂O₅ is obtained as 18.13 nm.
- ✓ The absorption spectra show absorption exclusively in the UV region and hence can be
- ✓ used in filters and sensors for UV radiation
- ✓ The calculated energy band gap of nano sized Nb₂O₅ from Tauc's plot is 3.1 eV
- ✓ Photoluminescence properties of the sample are studied.

REFERENCES

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- [3] K. Binnemans, C. Gorller-Walrand, On the color of the trivalent lanthanide ions Chemical Physics Letters, 1995, 235, pp. 163-174.

Journal Publications

FERGY JOHN, " SYNTHESIS, STRUCTURAL AND DIELECTRIC PROPERTIES OF Nb₂O₅ NANO-PARTICLES: A PROMISING FUNCTIONAL MATERIAL", *International Journal of Advance Research in Science and Engineering*, ISSN 2319-8354, volume 6, issue 3, 2017.

Conference Presentations

Fergy John and Sam Solomon, Structural studies of Nb₂O₅ nano particles synthesized by chemical precipitation method, presented in "New trends in materials science (NTriMS 2016)" St. Michael's college, Alappuzha.