

## Research Centre 2

Subject : Chemistry

### Centre for Study on Dye sensitized nano-composite doped polymer films for Optical Limiting & Optical Phase Conjugation



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#### Description :

Nanophotonics is an emerging area where nanotechnology is used to change the physical and chemical properties of photonic materials or the effectiveness of photonic processes which have major applications in optical communication, and optical computation. Though many photonic devices are developed using the nonlinear optical materials, the efforts are still on to increase their efficiency towards 100 % and other device characteristics towards their optimum level.

In order to improve the efficiency of the third harmonic processes further, we have a plan to use dye sensitized metal nanoparticles doped in PMMA films. It is expected that the ability of nanotechnology in tailoring the physio-chemical properties of the materials will give rise to the optimum nonlinear devices to be used in nanophotonics. A considerable improvement in both nonlinear optical susceptibility and laser damage threshold are expected based on the results published in case of dye sensitized metal nanoparticle doped solar cells. Such research may contribute efficient nanophotonic devices such as all optical switches which are the basic building blocks of the final dream of realizing all optical computers. The results of the research work will be published in international journals and patents.

#### Objectives :

- (1) Theoretical study on the effect of sensitization of nanomaterials by nonlinear dyes doped polymer matrix in order to change in dielectric and nonlinear susceptibility. This is achieved by the systematic study of the size of nanoparticles used for sensitization study, various donor-acceptor combinations, concentration of dyes and nanoparticles in the sample films.
- (2) Experimental study on preparation of metal nanoparticles, sensitizing them using nonlinear dyes, preparation of thin film samples using polymer matrix, study of change of nonlinear absorption, nonlinear refraction, and third harmonic susceptibility using Z-scan techniques.
- (3) Use of such sample films for experimental study of optical power limiting using Type 1, Type 2, and Type 3 configurations for various film parameters to find optimum parameters for concentration, thickness, and configurations.
- (4) Use of such film samples to study the possibility of generation of optical phase conjugation signal using four-wave mixing configuration.

## **Publications / Working Papers :**

- [1] **Shubhrajyotsna Aithal**, Aithal P. S. (2018). Theoretical Study on Metal nanoparticles sensitized Dye doped polymer films for Optical Limiting & Optical Phase Conjugation.
- [2] Application of Optical Phase Conjugation in Virtual Reality & Augmented Reality.
- [3] **Shubhrajyotsna Aithal**, Aithal, P. S. & Bhat, G. K. (2015). A Review On Sustainable Organic Materials for Optical Limiting Technology. *International Journal of Management, IT and Engineering (IJMIE)*, 5(7), 527-544. DOI : 10.5281/zenodo.62032.
- [4] **Shubhrajyotsna Aithal**, & Aithal P. S., (2016). ABCD analysis of Dye doped Polymers for Photonic Applications, *IRA-International Journal of Applied Sciences*, 4(3), 358-378. DOI : <http://dx.doi.org/10.21013/jas.v4.n3.p1>.
- [5] **Shubhrajyotsna Aithal**, Aithal, P. S. & Bhat, G. K. (2013). Study of Optical Limiting and Optical Phase Conjugation in DASPb dye-doped polymer films, *GSTF Journal of Physics and Applications (JPA)*, 1(1), 15-24. DOI: 10.5176/2335-6901.1.1.3.
- [7] **Shubhrajyotsna Aithal**, Aithal, P. S. & Bhat, G. K. (2013). Degenerate four-wave mixing in DASPb dye-doped polymer film, published in Part IV Quantum Optics, Chapter 12, *Advances in Laser Physics and Technology*, Edited by Man Mohan, Anil Kumar Maini, Aranya A. Bhattacharjee and Anil K. Razdan under the imprint of Foundation Books, Cambridge University Press India Pvt Ltd., pp. 179 - 195, ISBN: 978-93-844634-1-0., DOI : 10.5281/zenodo.62048.
- [8] **Shubhrajyotsna Aithal**, Aithal, P. S. & Bhat, G. K. (2012). Phase Conjugation in Two Photon Absorbing Dye films by Degenerate Four-wave Mixing, 3<sup>rd</sup> International Conference on Photonics 2012, 1-3 October 2012, Penang, Malaysia. Published in IEEEXplore ISBN: 978-1-4673-1463-3, pp.235-239.
- [9] **Shubhrajyotsna Aithal**, & Aithal, P. S. (2012). Study of Phase Conjugated wave in DASPb dye-doped polymer films, Photonics Global Conference 2012, 13-16, December 2012, Nanyang Technical University, Singapore. In *Photonics Global Conference (PGC)*, Singapore, pp.1-5. IEEE. ISBN : 978-1-4673-2513-4, DOI:10.1109/PGC.2012.6458057.
- [10] **Shubhrajyotsna Aithal**, Aithal, P. S. and Bhat, G. K. (2016). Study of Low Power Degenerate Four-Wave Mixing in Disperse Yellow Dye-doped Polymer Film. *International Journal of Engineering Research and Modern Education (IJERME)*, 1(2), 200-209. DOI: <http://dx.doi.org/10.5281/ZENODO.198716>.
- [11] **Shubhrajyotsna Aithal**, Aithal, P. S. & Bhat, G. K. (2017). Study of Third Order Optical Nonlinearity in DASPb Dye-doped Polymer Films using CW Laser. *Saudi Journal of Engineering and Technology (SJEAT)*, 2(1), 32-48. DOI : <http://doi.org/10.21276/sjeat.2017.2.1.4>.

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