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Micro and Nanoelectronics Facilities at SGSITS, Indore

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Abstract- The department of Applied Physics at SGSITS, is established in the year 1952. Currently, the department runs PG courses in M.Sc. (Applied Physics) and M.Tech. (Optoelectonics). Over the years the department has established itself as a premier institute for theoretical and experimental facilities in the areas of Laser, Optical Communication, Biomedical Imaging, Nonlinear Optics and Quantum Optics.The Department also has a National MEMS Design Center with support of NPMASS program of ADA, Bangalore. Under this center many simulation tools such as COMSOL Multiphysics, Coventoware, Intellisuite, RSoftBeamPro are procured. Interested researcher wish to use the computational facilities are welcome.

Keywords - COMSOL Multiphysics, Coventoware

Introduction

The Applied Photonics Laboratory has various experimental facilities. Some of the major facilities includes (i) micro-Photoluminescence setup, (ii) Optical Tweezers, (iii) Optical Coherence Tomography Setup (iv) Inverted Optical Microscope (metallurgical), (v) CO2 laser (vi) Nd:YAG laser (pulsed, cw), (vii) Nitrogen Laser (viii) He-Ne Laser (ix) Optical Spectrum Analyser (x) MOCVD setup, (xi) Thermal evaporation unit (xii) Digital Holography Setup (xiii) Automated Magneto Optic setup, etc. The research scholars, students and faculty members interested work with this setup may book and use the facilities.

The major part of National MEMS Design Center (NMDC) is supported by NPMASS program of Govt. of India. Other facilities are developed using the funding received from DST-New Delhi, AICTE-New Delhi, DRDO-NewDelhi, UGC-New Delhi and others.

A summary of various activities are given below:

(i) Micro-Photoluminescence and Optical Tweezers

In an optical tweezers, a high intense laser beam is focused to aa very small spot size. This in turn creates large gradient force on particles. The optical pressure exerted on such transparent particles could be understood using the net gradient and scattering forces on the particle, ignoring the thermal forces as shown in Figure 1. A very sharp gradient force may capture particles of sizes smaller than the wavelength. By suitable arranging the experimental setup the trapped particle inside the optical tweezers could be excited with a high energy beam laser and the Photoluminescence could be captured using spectrograph and optical tweezers assembly. As shown in Figures 2 and 3, the micro-photoluminescence is studied at the Institute.

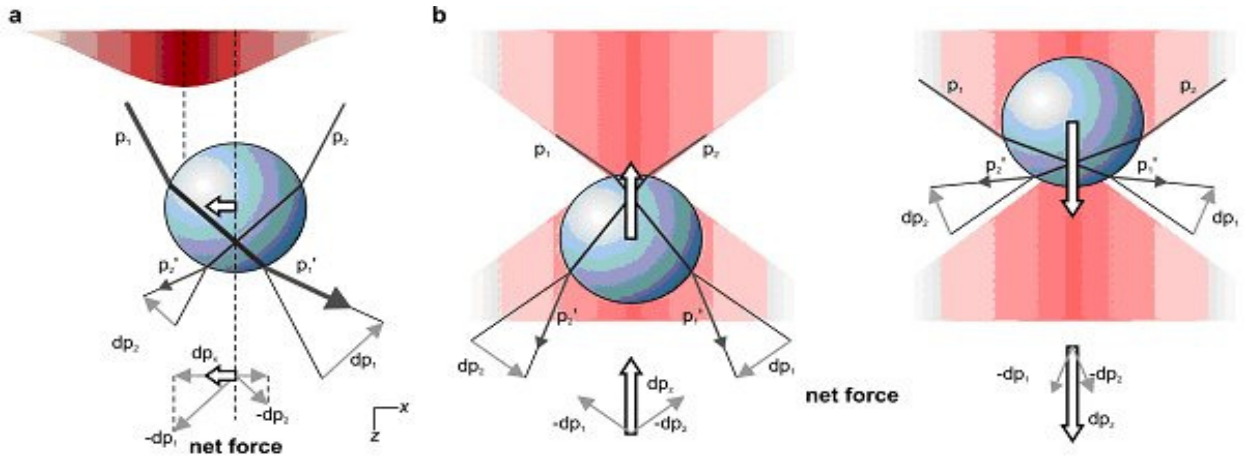

Figure 1. Schematic diagram of various forces acting on a transparent particle in an optical trap

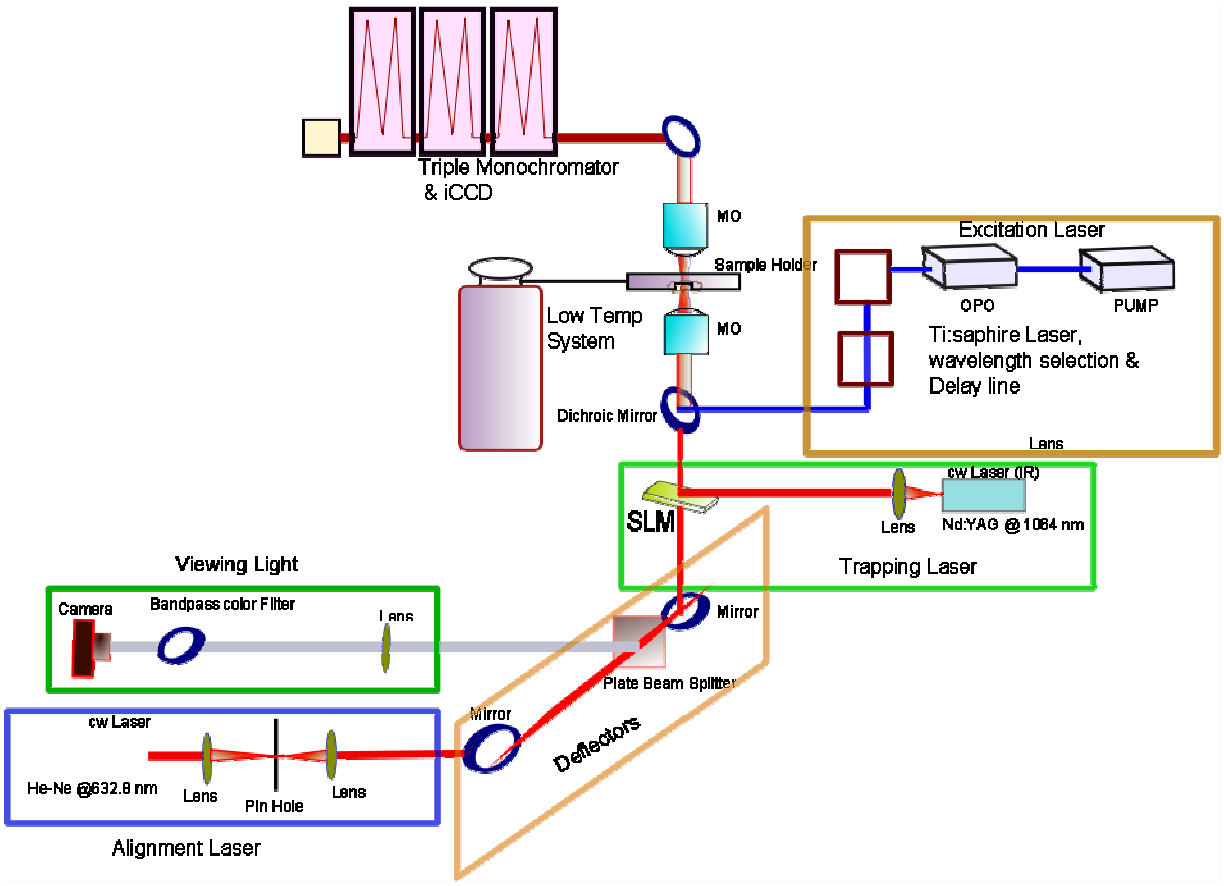

Figure 2. Schematic diagram of the experimental setup of micro-photoluminescence setup

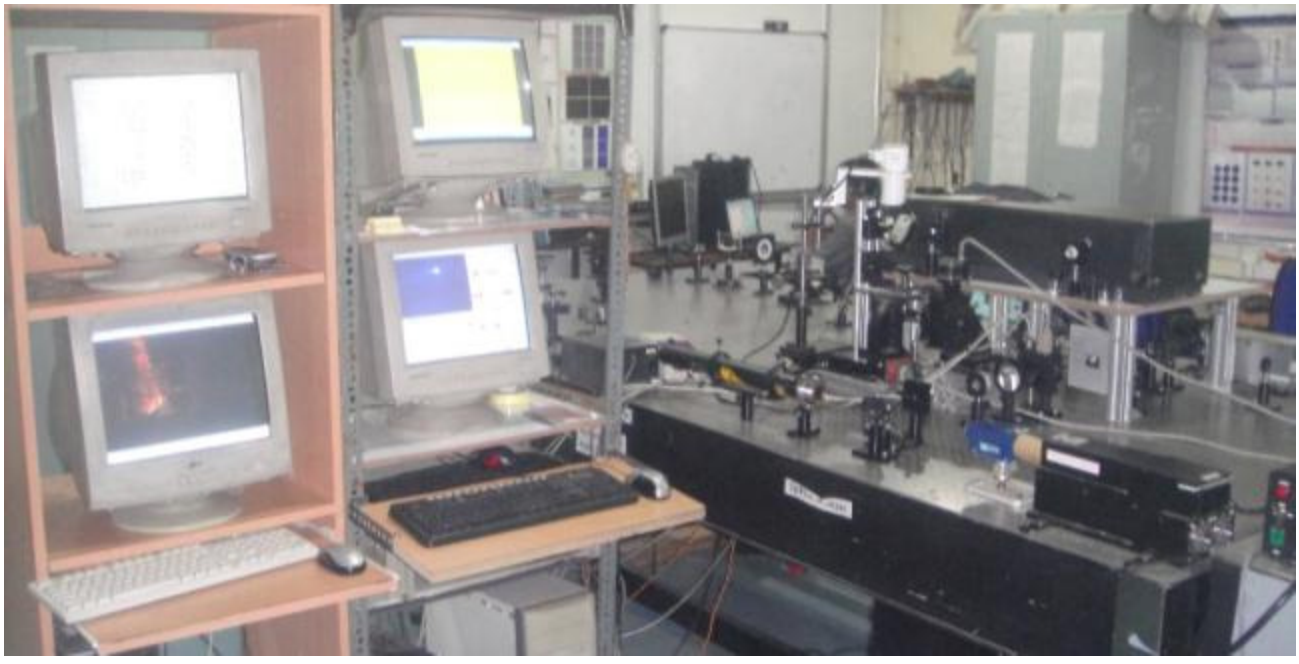

Figure 3. Photograph of the experimental setup of micro-photoluminescence at Department of Applied Physics

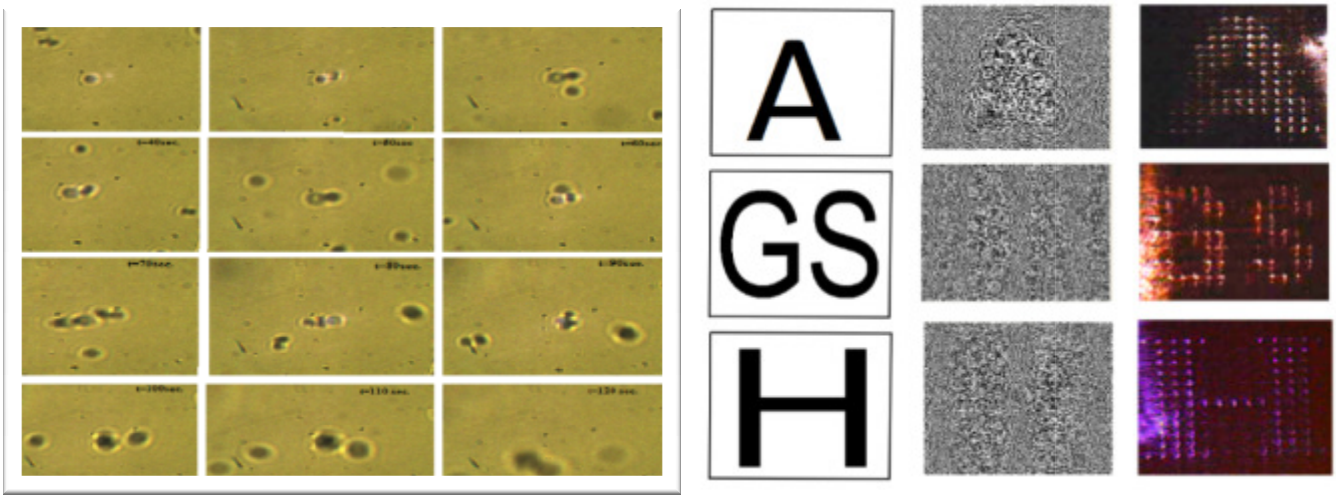

Figure 4. Sample of of trapped particles in a single beam (shown at left side) and the particles trapped in patterns (o thright).

(ii) Optical Coherence Tomography Setup (OCT)

OCT is an imaging modality works on the idea of heterodyne detection. Sample under study is diagnosed non-invasively. This optical imaging tool could image upto 10mm x 10mm in area and to a depth of few mm. The images have a spatial resolution of few tens of micrometer to axial resolution of few micrometers. The Applied Photonics Laboratory has three home made bulk optical coherence tomography setup. Also, the laboratory has home designed miniaturized optical coherence tomography setup which has a foot print of less than 4mm^2. Figure 5 shows the photograph of the bulk setup available at the laboratory. Figure 6 exhibits the schematic of the MOMES optical coherence tomography setup. Various miniaturized components are also shown in the figure. Figure 8 is a micro-photograph of the device magnified to 200 times using inverted metallurgical microscope.

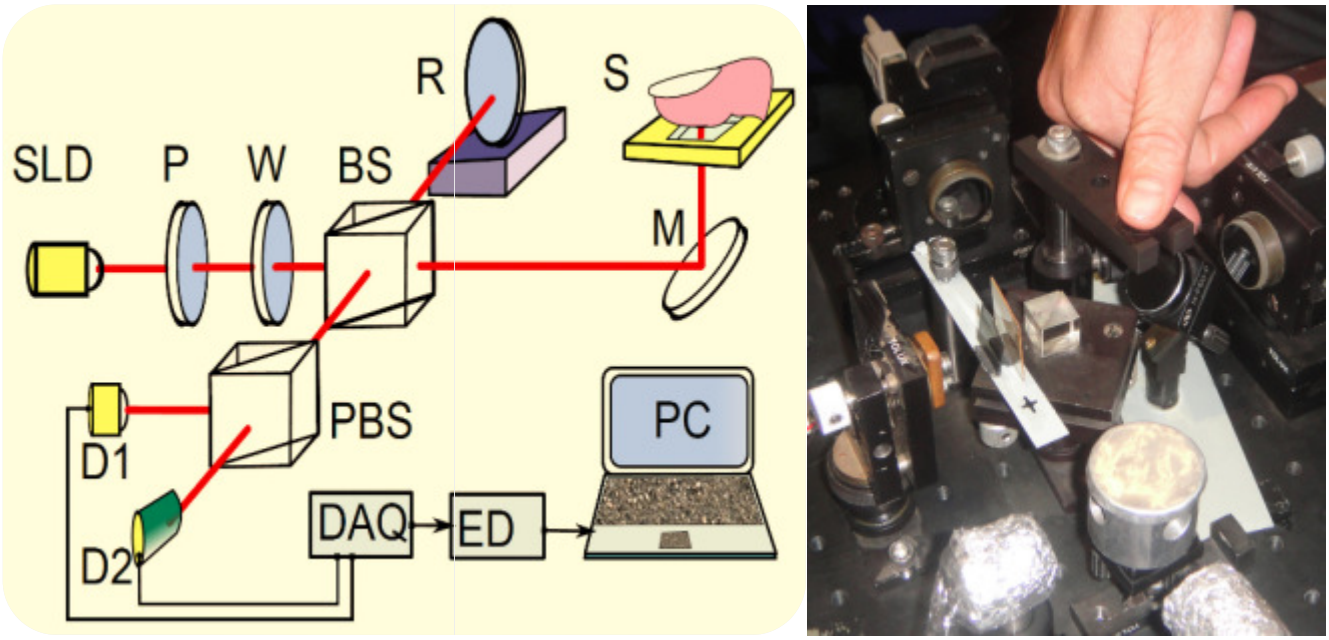

Figure 5. The schematic diagram shown at the left side the experimental setup and the Photograph of the setup on the right side of Optical coherence tomography

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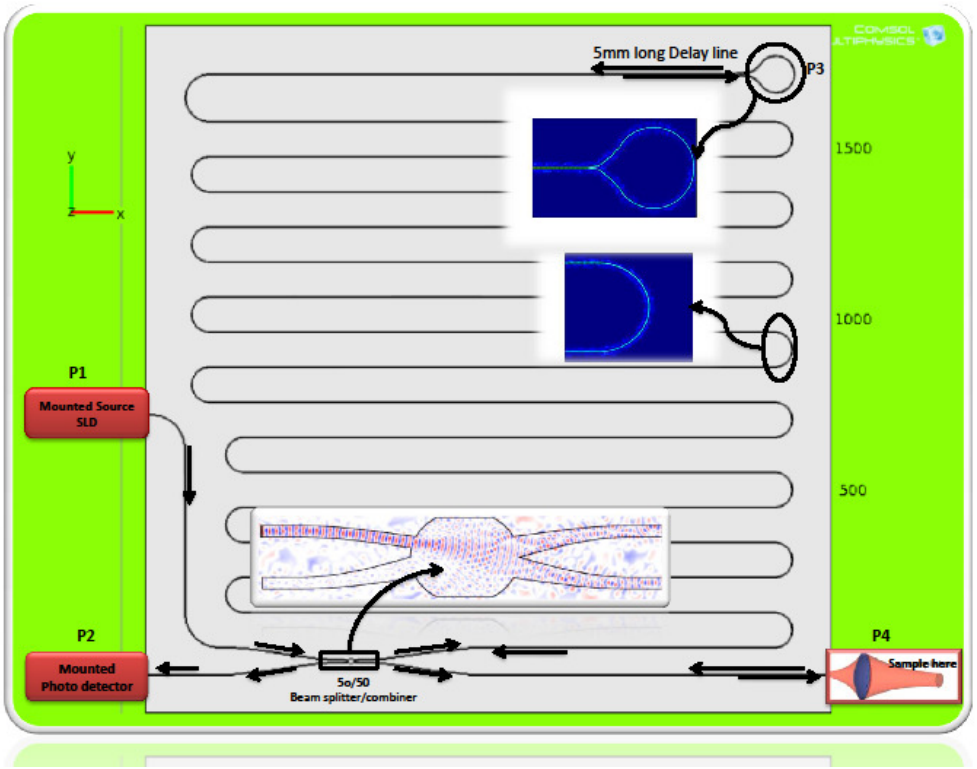

Figure 6.MOEMS Michelson interferometer showing various optical components.

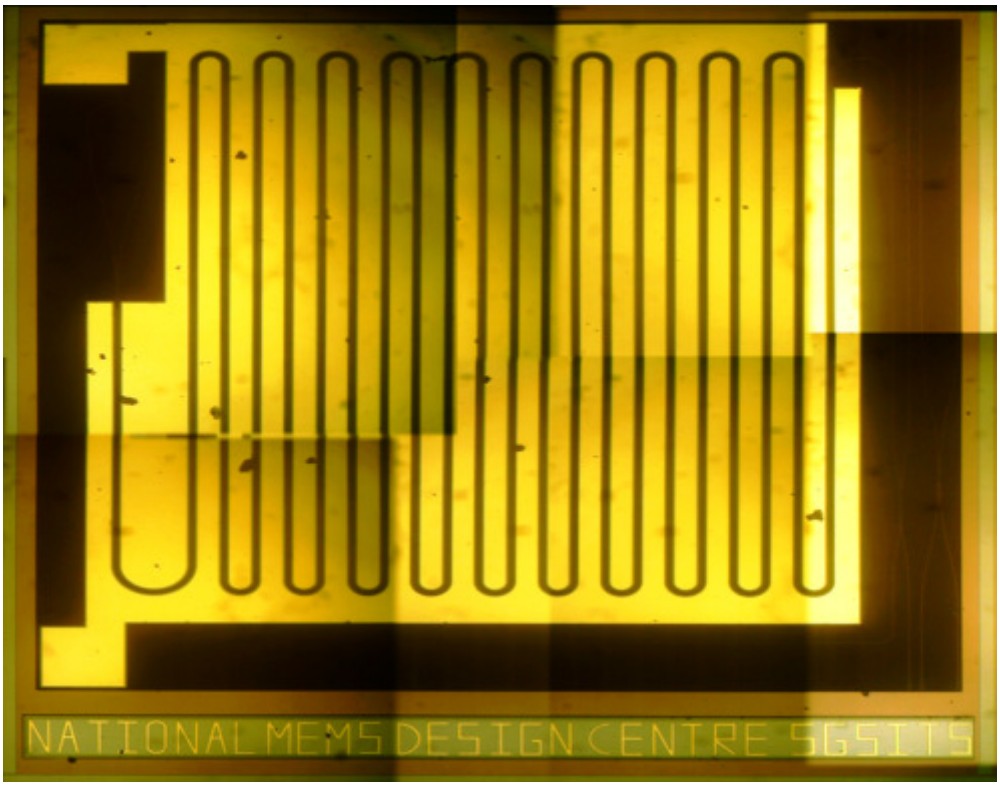

Figure 7. A micro-photograph of the MOMES device designed and fabricated by the research group members. The size of the device is less than 2mmx2mm.

(i) Software and Computational Facility

a. COMSOL Multiphysics
b. Intellisuite
c. Coventorware
d. RsoftBeamPro
e. Optiwave – Optisys
f. Tanner EDA Ledit
g. Server and 40 Nodes

(ii) Other major facilities

The department has various facilities for use in the Applied Physics and Optoelectronics Laboratories. The facilities are offered to the PG students of M.Sc. (Applied Physics) and M.Tech. (Optoelectronics) as well as to Research Scholars. Following list summarized some of the major facilities available:

a. Inverted Optical Microscope (metallurgical) upto 1000X magnification
b. Fabrication of Long period fiber grating using CO2 laser
c. Other Lasers
    i. Nd:YAG laser (pulsed, cw),
    ii. Nitrogen Laser
    iii. He-Ne Laser
d. Optical Spectrum Analyserwith resolutionupto 2nm
e. MOCVD setup for II-IV semiconductors
f. Thermal evaporation unit for thin metallic layer
g. Digital Holography Setup – non destructive testing and Plasma diagnostics
h. Automated Magneto Optic setup (upto 2T electromagnetic with poles)

Conclusions

The talk summarizes some of the major facilities available for research students of Micro-nano electronics at the Department of Applied Physics of the Institute. The facilities at National MEMS design could be used free of cost, while a nominal charge may be paid for using other facilities.

References:

[1]. J. Solanki, O.P. Choudhary, P. Sen, J. T. Andrews, *Review of Scientific Instruments,* **84**, 073114 (2013).1
[2]. J. T. Andrews, OCT News, February 21, 2012.
[3]. J. Solanki, P. Sen, J. T. Andrews &K. K. Thareja, *J. Modern Physics*, **3,** 1745 (2012).
[4]. J. Solanki, P. Sen, J. T. Andrews &K. K. Thareja, *J. Optics,* **41**, 127 (2012).
[5]. S. Chattopadhyay, P. Sen, J. T. Andrews, P. K. Sen, *J. Appl. Phys*, **111**, 034310 (2012)
[6]. J. T. Andrews,J. Solanki, Om P Choudhary, S. Chouksey, N. Malvia, P. Chaturvedi and P. Sen.
[7]. *J. Phys.: Conf. Ser., **365**,* 012004 (2012).
[8]. M. S. Qureshi, P. Sen, J. T. Andrews and P. K. Sen, *IEEE. J. Quantum Electronics,* **45**, 59 (2010).