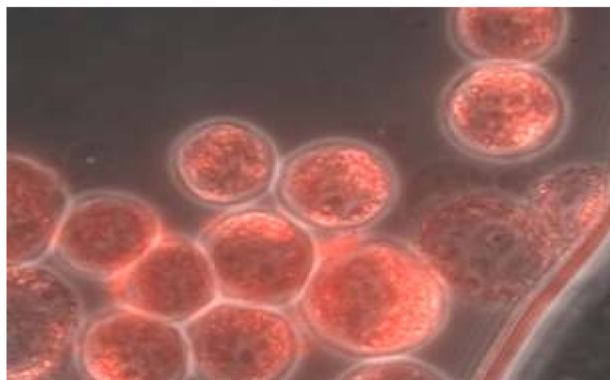

Fig. L.10.2: Fluorescence images (superimposed with phase contrast image) of Colo cells containing Nile Red doped Si-NPs after one hour incubation time. Excited at 532 nm and emission collected after 580 nm.

To use these fluorescent Si-NPs for cellular imaging, C35 is not a desirable fluorescence label because its excitation is near UV region, which may adversely affect cells. Therefore, the Si-NPs were loaded with another fluorescent dye, Nile red, having excitation wavelength in the green region and its uptake was monitored in the Colo cells by fluorescence microscopy. Incubation of Colo cells with Nile Red doped Si-NPs was observed to lead to significant intracellular staining (Fig.L.10.2). These results show that Si-NPs with appropriate functionalization may be used as fluorescent probes to target intracellular objects.

Contributed by:
K Das (kaustuv@cat.ernet.in), A. Uppal, B. Jain, B.Bose, and P. K. Gupta

L.11 : Development of high power laser diodes

High power laser diodes in the wavelength range of 740 nm to 1000 nm have been developed in the Semiconductor Laser Section of SSLD. The complete laser structure was grown by metal organic vapour phase epitaxy (MOVPE) technique. A typical semiconductor laser structure is consisted of about 10 epilayers with different composition, thickness and doping values. For example, a laser diode operating at 0.8 μm has either GaAs or GaAsP quantum well as an active layer. The quantum well is sandwiched between AlGaAs wider band gap waveguide and cladding layers. Laser structures were characterized using several techniques like photoluminescence, surface photo voltage and high resolution x-ray diffraction techniques. The ionized doping and free carrier density were estimated from Hall and ECV experiments. The net ionized doping was also estimated at different depth of the laser diode structures using ECV. Laser diodes were fabricated through standard procedure using photolithography process. A quick method of laser diode processing has also been successfully implemented using shadow mask technique. Laser diodes were tested for light versus current and longitudinal characteristics using a home-made current source. Laser diodes with different cavity lengths and widths were also developed and tested for measuring the device parameters. For the laser diodes developed, an internal quantum efficiency of 92% and internal loss of 4 cm^{-1} was measured. More than 5 watt peak power at several wavelengths was achieved.

Contributed by :
T. K. Sharma (tarun@cat.ernet.in)

L.12 : Fundamental studies on MOVPE grown semiconductor heterostructures

a. Studies on MOVPE growth of GaP epitaxial layer on Si (0 0 1) substrate and effects of annealing :

Growth of gallium phosphide layer on silicon substrate has been carried out using MOVPE. Epitaxial layers were grown at 845°C with a V/III ratio of 100 and a growth rate of 1.7Å/s at a reactor pressure of 30mbar. Growth of gallium phosphide epilayer was confirmed by Raman spectra studies. High-resolution x-ray diffraction studies show that the epilayer is of single crystalline nature and structurally coherent with silicon substrate. As-grown epilayer shows p-type behavior with a hole carrier density of ~$1.2x10^{18}cm^{-3}$ and hole mobility $114 cm^2$/V-sec at room temperature. Annealing at 550°C for 10 minutes shows significant improvements in crystalline quality of the epilayer. The annealed layer shows a reduced hole density (~$6.7x10^{17}cm^{-3}$) and increased hole mobility ($155cm^2$/V-s). [*Ref: Dixit et. al., J. Crystal Growth 293, 5, 2006*]