the ripening time.

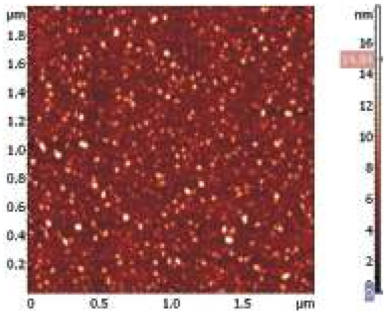

Fig L.10.1 : AFM picture of InAs QD

Figure L.10.1 shows an AFM scan of the optimized QD sample where a QD density of about $2x10^{10}$ cm^{-2} was obtained. The typical QD diameter was about 30 nm with the height of about 15 nm under optimized MOVPE growth conditions.

b. InP quantum dots :

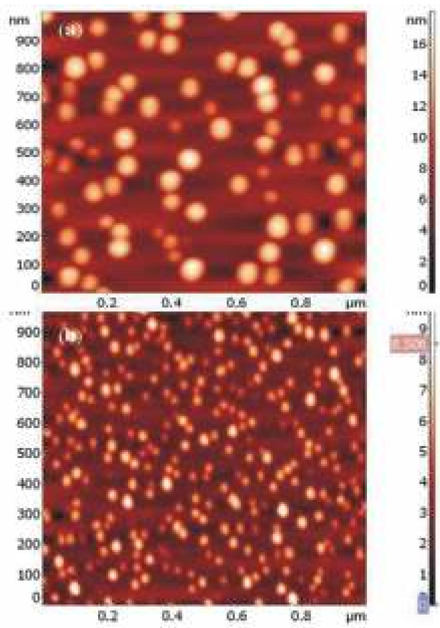

Fig.L.10.2 : AFM pictures of InP QD grown at a temperatures of (a) 600 ^{0}C and (b) 550 ^{0}C

InP self-assembled quantum dots (QDs) have been grown on a nominally (001) oriented n^+-GaAs substrate through Stranski-Krastanov growth mode. InP/GaAs QD system has type-II band alignment, where only electrons are confined in the QD region while holes are in the GaAs barrier regions. Structural properties of the InP QDs were optimized by varying the InP coverage, growth temperature, V/III ratio, growth rate etc. Variation of growth temperature on the structural properties of InP QD are shown in Fig.L.10.2, where it was observed that the QD size decreases while the density increases with the decrease in growth temperature.

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L.11 : Ab initio study of the electronic and geometric structures of ultra-small single-walled nanotubes

All-electron calculations based on density functional theory have been carried out at Semiconductor Laser Section to study the electronic structures of single walled nanotubes with sub-nanometer diameters. Our studies emphasize the need for performing all-electron calculations, specifically for the nanotubes with very small diameters. A complete geometry optimization is found to be very crucial for predicting the correct electronic properties of these tubes. In the band structures of these tubes, systematic variations of a nearly-free-electron-like-state and a nearly-dispersion-free-state are observed as a function of n. From this one is able to indicate the possibility of accumulation of a *large density of states at the Fermi level*, after moderate hole or electron doping, in some of these tubes, which make them interesting for further probing. The Fermi surfaces calculated for the metallic SWCNTs show the signature of a collection of *quasi-Fermi-points*. This clearly shows the quasi-one-dimensional nature of these tubes [For more details, please see: *C. Kamal et al, Phys. Rev. B, 76, 075113, 2007*].

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L.12 : Development of zinc sulphide blanks and domes using chemical vapour deposition technique

Zinc Sulphide (ZnS), due to its transparency in the infrared region (8-12 μm range) and good mechanical strength, is used as protective windows to shield high quality infrared imaging systems on airborne platforms and as infrared optical elements. At Laser Materials & Device Development Division of RRCAT, sub-atmospheric pressure Chemical Vapour Deposition (CVD) process has been successfully implemented to produce dense, highly pure, crystalline ZnS blanks and domes of aperture size up to 80 mm. A schematic of homemade CVD reactor is shown in Fig. L.12.1.

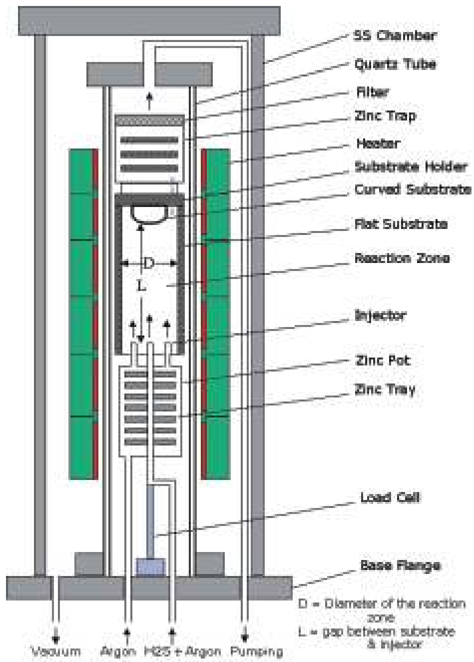

Fig. L.12.1 Schematic diagram of CVD reactor

Fig.L.12.2 Stand-alone ZnS after polishing in different shape

Inert carrier gas (argon) is passed over molten Zn (~ 600°C) contained in a graphite pot, to pick up Zn-vapour, and fed into the base of the reactor. High-purity H_2S gas, along with the inert carrier gas, controlled through mass flow controllers and meters, is also fed into the base of the reactor. The chemical reaction leads to the formation of ZnS that gets deposited on the walls of the cylindrical reactor, as well as on the substrate kept at the top of the reactor. Un-reacted or excess Zn remaining in the gas stream is dumped into the carbon dump box above the growth box mandrel before the effluent gas is removed from the CVD reactor by a rotary vacuum pump. The effluent gas is sterilized of any residual H_2S gas by passing it through a scrubbing tower with a spray of sodium hydroxide (NaOH) solution. The treated gas is tested for any H_2S traces and then let out into the atmosphere through a tall chimney. Good quality blanks were obtained at ZnS deposition rate of the order of 1 μm/minute. X-ray diffraction measurements on ZnS blanks confirmed cubic structure with a lattice parameter of 5.405 Å. Microstructure study using the scanning electron microscope and atomic force microscopy revealed no porosity and average grain size of ~ 50 nm for a ~ 0.6mm thick ZnS blank

Figure L.12.2 shows a picture of free-standing, ZnS blank and dome. Both the blank and dome can be seen to have good transparency. The transmission spectrum of a ~ 2.0 mm thick flat blank in the 8-12 μm wavelength range is shown in Fig. L.12.3. The measured transmission value of ~ 70% compares well with the commercially available blanks. The measured density of the blank (~ 4.10 gm/cc) and its Vicker's hardness (~ 200) was also comparable to reported values.

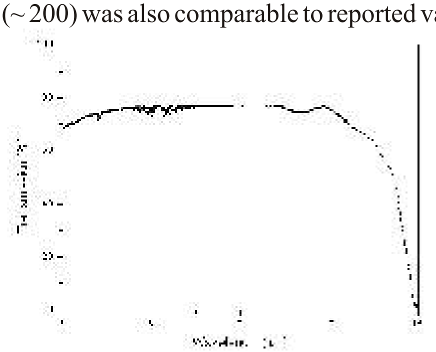

Fig.L.12.3: Transmission spectrum of transparent ZnS blank

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L.13 : Nonlinear optical studies in neutral red dye under nanosecond laser pulse excitation

In the recent past, rapid technological advancements in optics have placed great demand on the development of nonlinear optical materials suitable for photonic devices. Organic chromophores exhibit versatility of synthesis, their nonlinear optical (NLO) properties can be custom-tailored for a specific application. One of the important applications of these materials is in optical limiting devices used to protect