The plasma expansion velocity and its variation in time has been calculated from the shadowgrams and the measured peak expansion velocity was ~1.8×10^7 cm/s. Similarly, the time resolved interference fringes have been used to get the density profile at different axial distances from target surface.

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L.12: Development of Nitride MOVPE system

Nitride semiconductors are becoming increasingly important in various areas of optoelectronic, high speed and power devices. Metal Organic Vapor Phase Epitaxy (MOVPE) is one of the most widely used techniques for the deposition of these materials. Keeping in view the importance of Nitride semiconductors and MOVPE growth process, we at SCLS have developed an MOVPE system for the growth of Nitride semiconductors. In this article, the salient features of this system are presented.

The process of MOVPE involves a vapor phase reaction between a Metalorganic compound and a hydride gas (referred to as precursors), which are transported to a heated substrate by a carrier gas (N_2 or H_2), resulting in the growth of the desired material on the substrate. In case of GaN, this reaction is as follows: $(CH_3)_3Ga + NH_3 \rightarrow GaN + 4CH_4$. For the deposition of other nitrides like InN, AlN and their ternaries, the precursors used are $(CH_3)_3In$ and $(CH_3)_3Al$ or their combinations. A strict control of the thickness and composition of these epilayers and high material purity are the prerequisites for an MOVPE system. Fig L.12.1 Schematic of the Nitride MOVPE system

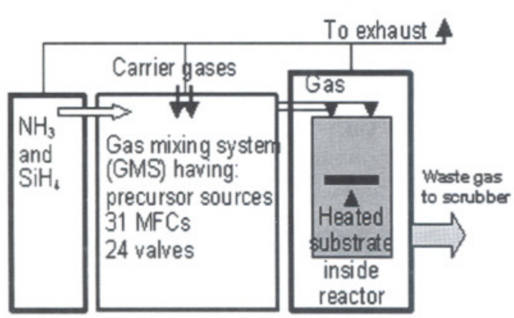

Fig L.12.1 Schematic of the Nitride MOVPE system

Fig. L. 12.1 shows the schematic of the system. The flows of the gases are controlled by mass flow controllers (MFCs) (31 nos) and switching of the various precursors is controlled through a large number of fast switching air actuated valves (24 nos). These devices are controlled through several field controllers and a Labview based GUI, which have been developed and implemented by LESD, RRCAT [RRCAT Newsletter, Vol. 22(1), p14, 2009].

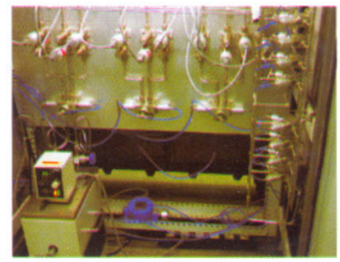

Fig L.12.2. A view of the gas lines and components in a part of the GMS

The high purity of the deposited material is ensured by the use of purifiers for the various gases (NH3, N2 and H2) and the leak tightness of the system (better than 10^{-9} Torr Lit/sec of He). All the MFCs and the switching valves are located in the Gas Mixing system (GMS), that has been assembled by welding ¼ inch OD electro polished from inside SS316L tubes to the various gas components. The view of a part of the (GMS) is shown in Fig L.12.2

The required gases flow into a reactor, where a substrate (Sapphire in our case) is kept at elevated temperatures, to facilitate the growth reaction between the precursors. A high purity Molybdenum based Heater is used to heat the substrate to 1100°C. The external view of the reactor is shown in Fig. L.12.3. To ensure uniform injection of the gases into the reactor without any premixing, a specially designed gas injection showerhead was developed. The showerhead has been designed in our section and was fabricated in Workshop B. Finally the un-reacted precursors pass through a scrubber to avoid any health hazards and environmental contamination. High crystalline quality GaN layers with strong band edge photoluminescence have been deposited in the above system.

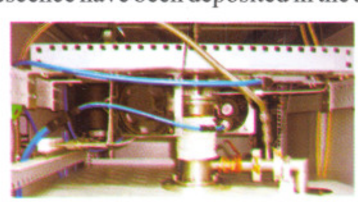

Fig L.12.3. The reactor developed at RRCAT for the Nitride MOVPE system.

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