OPERATION AND UPGRADATION OF LOW ENERGY ACCELERATOR FACILITY AT BARC

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Abstract

A Low Energy Accelerator Facility (LEAF) has been set up at BARC which is in operation with several beams available to the users. The facility can deliver singly charged negative ion beams of energy upto 50 keV. Already H^- , Li^- , C^- , O^- , Al^-, Fe^-, F^- , Si^-, S^-, P^-, Sb^-, Ag^- and Au^- beams have been extracted and delivered to the users.

Experiments have been done with H^-, Li^-, C^- , Si^-, S^-, P^- and Sb^- beams. Typical particle currents available on the targets are up to few micro amperes. Future plans include installing an electrostatic quadrupole triplet to focus the beam on target and a scanner to scan the beam uniformly on larger surface area and single button automated operation of the facility.

In this paper details of the facility will be presented.

BRIEF DESCRIPTION OF FACILITY

Low Energy Accelerator Facility (LEAF) is a DC electrostatic accelerator capable of accelerating negative ion beams up to 50 keV [1] (Figure 1). Negative ion beams are generated in a SNICS ion source and accelerated in an accelerating tube. Accelerated beams are bent through 90^0 by an electromagnet to take it to the experimental chamber. This electromagnet also works as a mass selector. To focus the beam on the target an einzel lens is used after the bending magnet. There are three sets of steerers, Faraday cups and beam profile monitors used as beam diagnostic and corrective devices.

Throughout the length of the beam line a vacuum of order 10^{-7} Torr is maintained. Two turbo pumps and one ion pump are used to maintain the vacuum during operation of the facility. The SNICS ion source is kept under vacuum continuously by a 35 LPS sputter ion pump when facility is not running. LEAF is controlled through computers. Control signals are communicated to high voltage area via fiber optic cable.

At the target beam size is approximately 5 mm dia. As the facility has large utilization for ion implantation studies a uniform raster scan on large sample is required. Preliminary studies for beam scanning have been done with an electrostatic steerer, by applying ramped voltage across the plates. This was repeated with the electrostatic beam scanner and resulted in a better beam uniformity while scanning.

UTILIZATION

Facility is running for last two years and has delivered various negative ion beams on the target. A list of extracted ion beams at 56 keV (50 kV acceleration Voltage + 6 kV cathode voltage) is presented in Table 1. Clusters of C^- ion from C_1 to C_{25} are extracted (Figure 2).

H^- Implantation work was carried out to study the effect of implantation on the optical wave guide. A series of experiments with different ion beams and with varying energy are carried out to study the effect of implantation on the photoluminescence of GaAs quantum dots [2] [3]. Experiments are carried out to study the effect of influence of Li^- on the optical and electrical properties of the ZnO films [4]. Experiments have been conducted with the P^- and B^- ion beams to fabricate tunnel transistor by bombarding them on Si substrate.

Figure 1: Low Energy Accelerator Facility at BARC

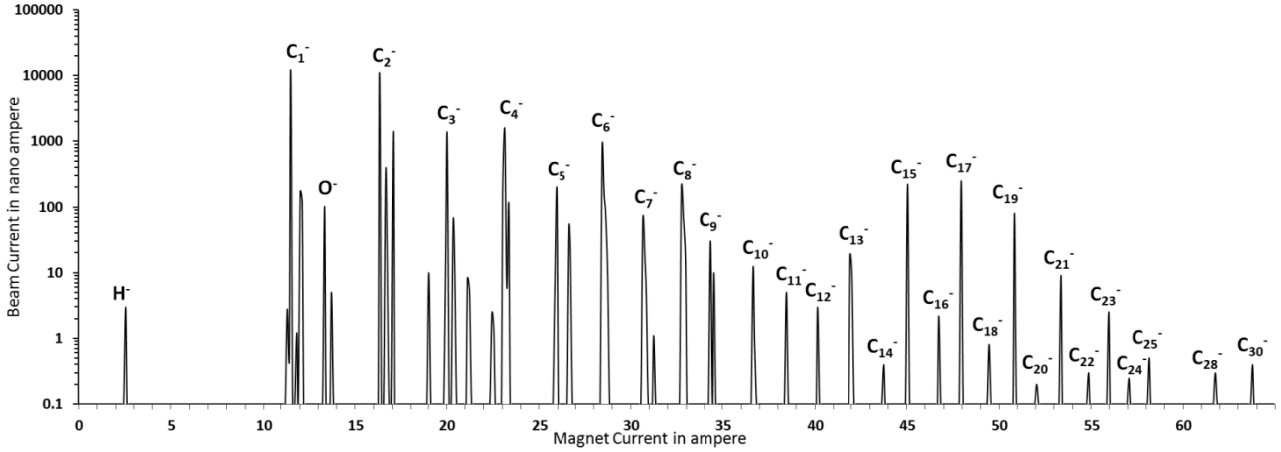

Figure 2: Carbon Cluster Spectrum

Apart from the experiments the facility is frequently used to test various newly designed and/or procured accelerator components which require ion beams for their testing such as BPM, Faraday Cups, and DCCT etc. Presently, discussion is going on to set up a Laser Beam interaction system in this facility.

Table 1: Extracted ion beams

Sample	Extracted Current	Beam	Analyzed Beam Current
TiH	10 μA	H-	5 μA
Graphite	90 μA	C-	25 μA
Fe2O3	28 μA	O-	15 μA
Silicone	20 μA	Si-	8 μA
LiF+Al	20 μA	Li-	0.3 μA
LiF+Al	20 μA	F-	12.5 μA
S	10 μA	S-	2.3 μA
AgI	30 μA	I-	10 μA
Pure Ag	5 μA	Ag-	0.6 μA
Pure Au	25 μA	Au-	12.5 μA
Sb	4.5 μA	Sb-	0.2 μA
P	15 μA	P-	0.3 μA
B + Ag	8 μA	B-	80 nA

FUTURE PLAN

Although LEAF is working satisfactorily there are areas where improvement can be done. It has been observed that einzel lens is not able to strongly focus the beam on target, that is, it is not able to make the beam size less than 5 mm diameter. To focus the beam further an Electrostatic Quadrupole Triplet (EQT) is being fabricated and will be installed very soon. Along with EQT a standard double slit is also being fabricated to further reduce the beam size on target.

A properly designed and tested scanner will also be installed along with the EQT and double slits. Second major improvement is to make the system operation automated so that with a single button press machine starts and beam is made available on the target within a certain amount of time and with minimum operator intervention. Presently work is on progress in this regard. Full automation is expected to be achieved within next six to eight months.

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