(f) Ion Beam Sputtering :

Sputter deposition under controlled high vacuum conditions can be achieved by using an ion beam source. In the primary ion beam deposition process, the ions of the required material are produced and condensed on a surface to form a thin film. In the secondary ion beam deposition process. The Ar^+ ions from a beam source are used to sputter a target in vacuum and condense the sputtered species on a substrate. Both techniques have undergone major technology developments in the last decade or so and have now become standard but expensive tools for utilizing the benefits of a sputtering process under vacuum deposition conditions.

The two ion sources commonly employed for deposition are the duoplasmatron and the one developed by Kaufman. In the duoplasmatron source, the ions are created in a glow arc discharge chamber and are then extracted through apertures into a second chamber at a much lower pressure ($\sim 10^{-4}$ torr). The Kaufman source employs chamber geometry and an applied magnetic field in such a way that the thermionically emitted electrons must travel long spiral path to an anode cylinder located in the outer diameter of the discharge region. This results in high ionization efficiency as well as a uniform plasma. Applying a potential difference between a pair of grid with precisely aligned holes causes the ions to be extracted from the sheath around the grid holes and then accelerated by this potential difference. The grid optics focus the ions into a well collimated beam which can be nutralized by injecting low energy electrons from a hot filament on the target side of the grids. Ion deposition has been used to deposit films of ITO on Si for SIS solar cells.

MOLECULAR BEAM EPITAXY (MBE) :

4.

Development of molecular beam epitaxy (MBE) has added a new dimension in deposition of thin epitaxial films. Superlattices, heterostructures and heterojunctions and advanced VLSI structures and novel devices [129]. The deposition of thin epitaxial film occurs due to condensation of one or more beam of atoms and/or molecules from effusion sources under UHV conditions on atomically cleaned surfaces. The effusion source consists of a metallic chamber containing the evaporant with a small orifice. The beam of atoms or molecules is directed on the substrate by orifice, slits and shutters. To control the deposition conditions in-situ techniques as electron diffraction. Auger electron spectroscopy (AES), electron spectroscopy for chemical analysis (ESCA), electron energy loss spectroscopy (EELS) etc. are built into the system. In MBE, the growth process of the film has a precise control over thickness, composition, crystalline perfection and doping impurities. This technique provides good reproducibility of the properties.