



# SNS COLLEGE OF TECHNOLOGY



Coimbatore-35  
An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with ‘A+’ Grade  
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

## DEPARTMENT OF MECHANICAL ENGINEERING

### 16MET202 – MANUFACTURING TECHNOLOGY II YEAR III SEM

#### TOPIC-EBM &LBM





# Introduction to EBM & LBM

- ❖ Electron Beam Machining (EBM) and Laser Beam Machining (LBM) are thermal processes considering the mechanisms of material removal.
- ❖ However electrical energy is used to generate high-energy electrons in case of Electron Beam Machining (EBM) and high-energy coherent photons in case of Laser Beam Machining (LBM).
- ❖ Thus these two processes are often classified as electro-optical-thermal processes.



# Electron Beam Machining

Electron beam is generated in an electron beam gun. Electron beam gun provides high velocity electrons over a very small spot size. Electron Beam Machining is required to be carried out in vacuum. Otherwise the electrons would interact with the air molecules, thus they would lose their energy and cutting ability.

The high energy focused electron beam is made to impinge on the workpiece with a spot size of 10 – 100  $\mu\text{m}$ . The kinetic energy of the high velocity electrons is converted to heat energy as the electrons strike the work material. Due to high power density instant melting and vaporisation starts and “melt vaporisation” front gradually progresses.



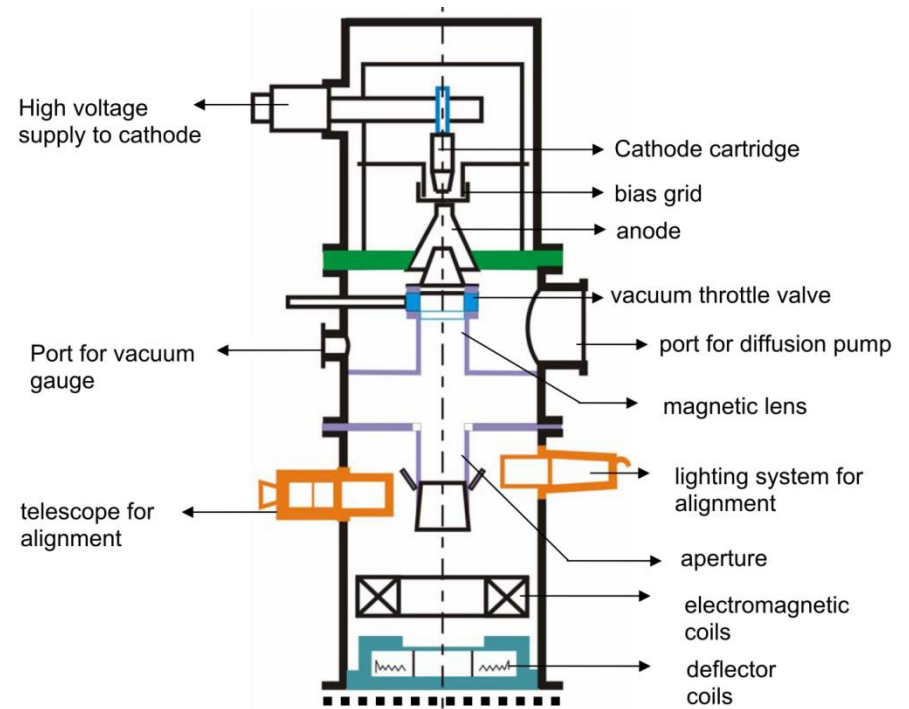
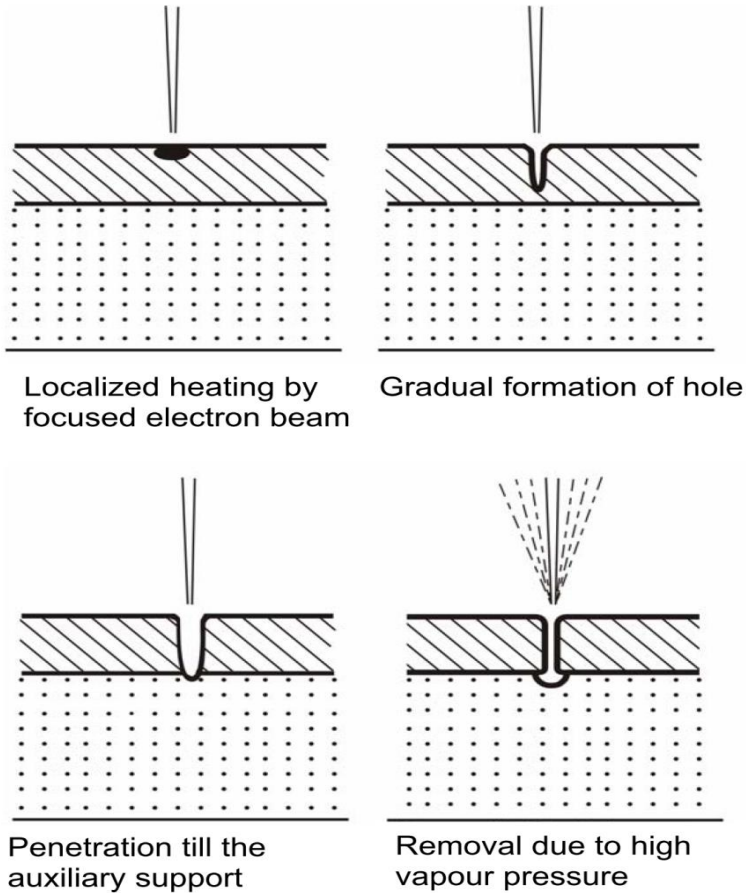
# Electron Beam Machining

Finally the molten material, if any at the top of the front, is expelled from the cutting zone by the high vapour pressure at the lower part.

Unlike in Electron Beam Welding, the gun in EBM is used in pulsed mode. Holes can be drilled in thin sheets using a single pulse. For thicker plates, multiple pulses would be required. Electron beam can also be manoeuvred using the electromagnetic deflection coils for drilling holes of any shape.



# MECHANISM OF MATERIAL REMOVAL IN ELECTRON BEAM MACHINING



**Schematic representation of an electron beam gun**



The process parameters, which directly affect the machining characteristics in Electron Beam Machining, are:

- The accelerating voltage
- The beam current
- Pulse duration
- Energy per pulse
- Power per pulse
- Lens current
- Spot size
- Power density



# ADVANTAGES & LIMITATIONS

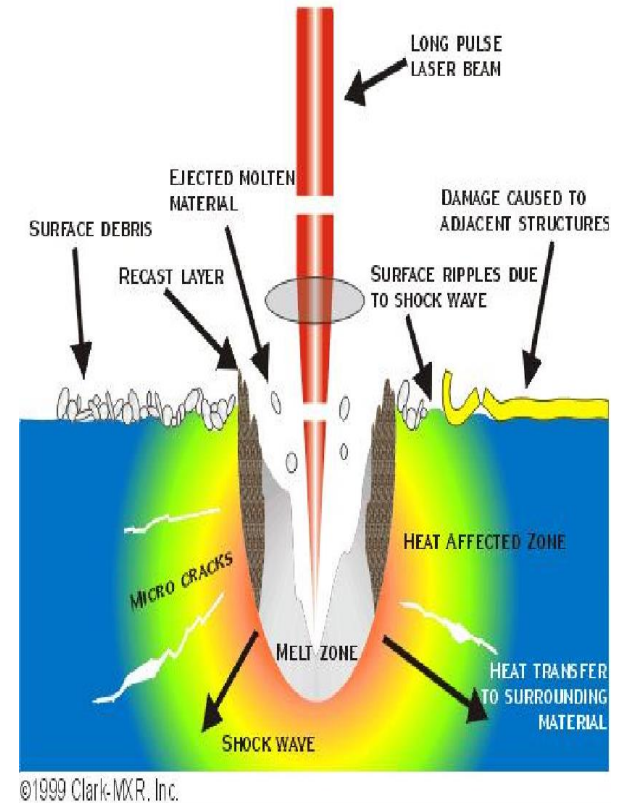


- ❖ EBM provides very high drilling rates when small holes with large aspect ratio are to be drilled.
- ❖ It applies no mechanical cutting force, work holding and fixturing cost is very less.
- ❖ EBM can provide holes of any shape by combining beam deflection using electromagnetic coils and the CNC table with high accuracy.
- ❖ The primary limitations are the high capital cost of the equipment and necessary regular maintenance applicable for any equipment using vacuum system.
- ❖ Though heat affected zone is rather less in EBM but recast layer formation cannot be avoided.



# LASER BEAM MACHINING

- ❖ Laser Beam Machining or more broadly laser material processing deals with machining and material processing like heat treatment, alloying, cladding, sheet metal bending etc.
- ❖ Such processing is carried out utilizing the energy of coherent photons or laser beam, which is mostly converted into thermal energy upon interaction with most of the materials.
- ❖ Lasing process describes the basic operation of laser, i.e. generation of coherent (both temporal and spatial) beam of light by “light amplification” using “stimulated emission”.







# ADVANTAGES OF LBM



- ❖ Excellent control of the laser beam with a stable motion system achieves an extreme edge quality. Laser-cut parts have a condition of nearly zero edge deformation, or roll-off
- ❖ It is also faster than conventional tool-making techniques.
- ❖ Laser cutting has higher accuracy rates over other methods using heat generation, as well as water jet cutting.
- ❖ There is quicker turnaround for parts regardless of the complexity, because changes of the design of parts can be easily accommodated. Laser cutting also reduces wastage.



# DISADVANTAGES OF LBM

- ❖ The material being cut gets very hot, so in narrow areas, thermal expansion may be a problem.
- ❖ Distortion can be caused by oxygen, which is sometimes used as an assist gas, because it puts stress into the cut edge of some materials; this is typically a problem in dense patterns of holes.
- ❖ Lasers also require high energy, making them costly to run.
- ❖ Lasers are not very effective on metals such as aluminum and copper alloys due to their ability to reflect light as well as absorb and conduct heat. Neither are lasers appropriate to use on crystal, glass and other transparent materials.



**THANKS!**