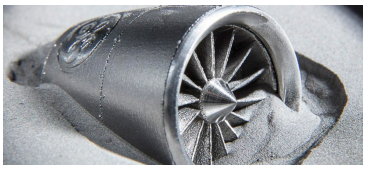

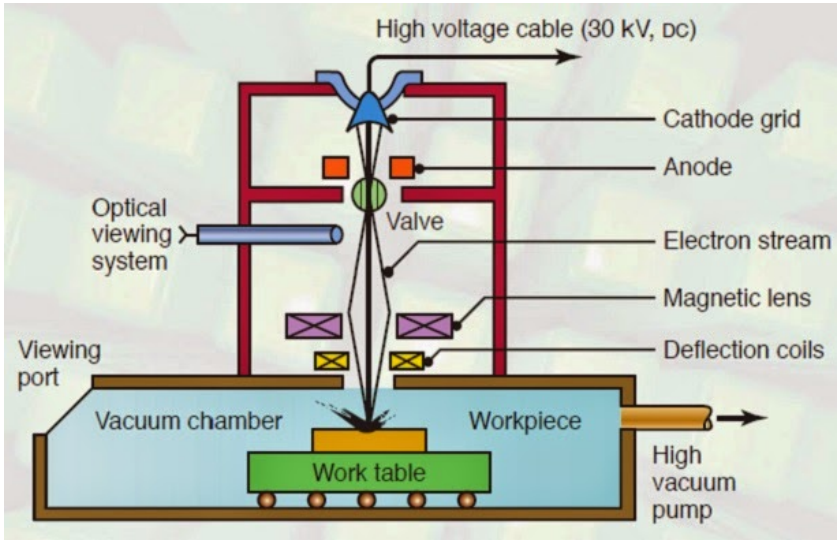

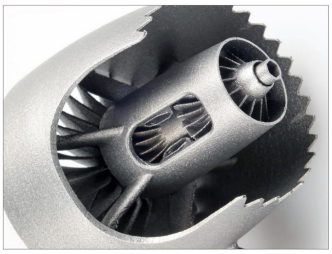

ELECTRON BEAM MACHINING (EBM)

Electron beam machining *is a process of machining materials with the use of a high velocity beam of electrons.* This process is best suited for *microcutting of material* (in mg/s) because the evaporated area is function of the beam power and the method of focusing which can be easily controlled.

Principle and Working : Refer to Fig.

In this process the material is removed with the help of a high velocity (travelling at half the speed of light. *i.e.,* 160,000 km/s) focused stream of electrons which are focused magnetically upon a very small area. These electrons heat and raise the temperature locally above the boiling point and thus melt and vaporise the work material at the point of bombardment.

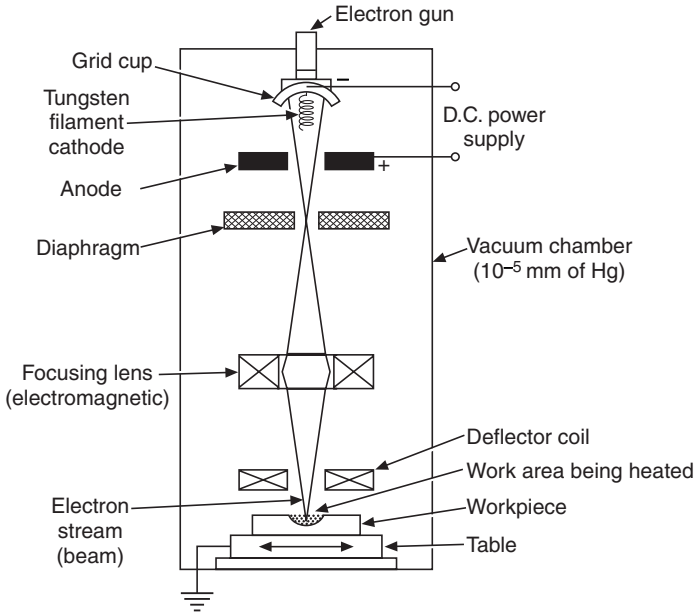

Fig. Set up for Electron Beam Machining (EBM).

The electrons are obtained in free state by heating the cathode metal in *vacuum* to the temperature at which they attain sufficient speed for escaping to the space around the cathode. These can then be made to move under the effect of electric or magnetic field and can be accelerated greatly. The acceleration is carried out by electric field and focusing and concentration is done by controllable magnetic fields.

Characteristics of EBM :

- *Workpiece materials* : All materials.
- *Material removal :* High speed electrons impinge on surface and K.E. of electrons produces intense heating to melt or vaporise the metal.
- *Voltage :* 150 kV.
- *Power density :* 6500 billion W/mm^2
- *Medium :* Vacuum (10^{-5} mm of Hg)
- *Specific power consumption :* 500 W/mm^3 min.

Advantages :

1. It is excellent strategy for micro-machining. It can drill holes or cut slots which cannot be otherwise made.
2. It can cut any known material, metal or non-metal that would exist in vacuum.
3. No physical or metallurgical damage.
4. There is no contact between the work and tool.
5. Heat can be concentrated on a particular spot.
6. Close dimensional tolerances can be achieved because problem of tool wear is non-existent.

Disadvantages :

1. Low metal removal rate.
2. High equipment cost.

3. High operator skill required.
4. Only small cuts are possible.
5. High power consumption.
6. Unsuitable for producing perfectly cylindrical deep holes.
7. Workpiece size is limited due to requirement of vacuum in the chamber.

Applications :

1. Micro-machining operations on workpieces of thin sections.
2. Micro-drilling operations (upto 0.002 mm) for thin orifices, dies for wire drawing parts of electron microcopes, fibre spinners, injector holes for diesel engines etc.
3. Very effective for machining of metals of low heat conductivity and high melting point.