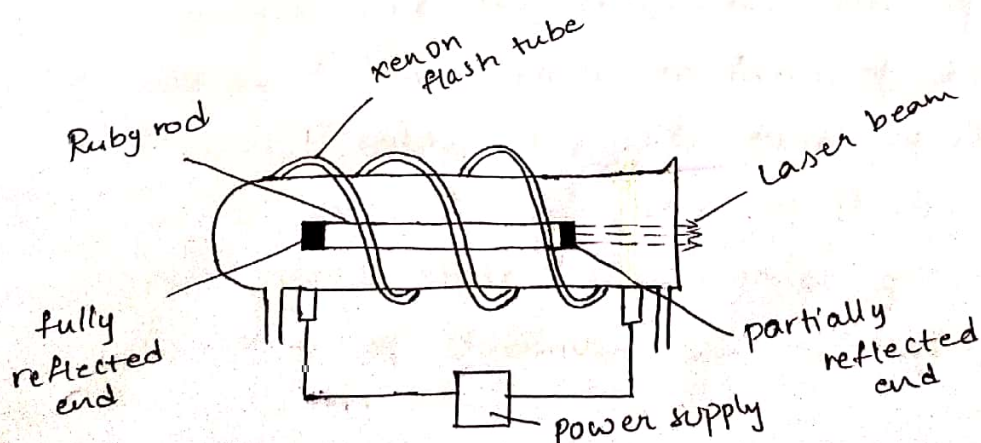


5. Ruby Laser

It is a three level solid state laser and was constructed by Mainmann in 1960. Ruby ($\text{Al}_2\text{O}_3 + \text{Cr}_2\text{O}_3$) is a crystal of Aluminium oxide in which 0.05% of Al^{3+} ions are replaced by Cr^{3+} ions. The color of rod is pink. The active medium in the ruby rod is Cr^{3+} ions.

Construction

In Ruby laser 4 cm length and 5 mm diameter rod is generally used. Both the ends of rods are highly polished and made strictly parallel. The ends are silvered in a way, one become partially reflected and other end fully reflected. The ruby rod is surrounded by xenon flash tube which provides the pumping light to excite the chromium ions to upper energy levels.

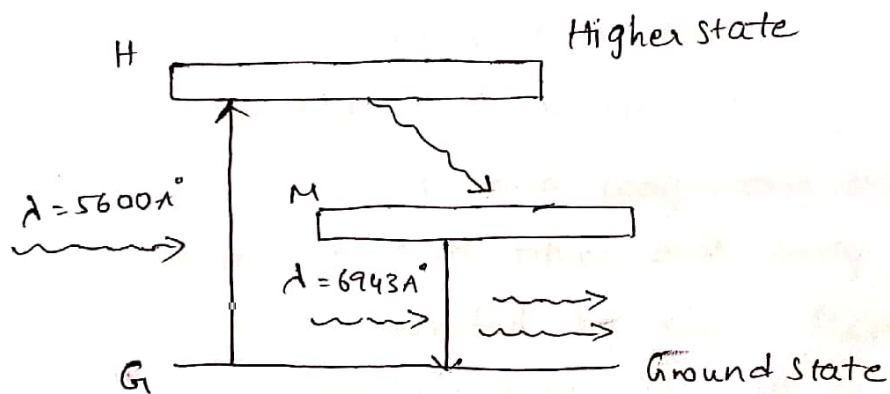


Xenon flash tube emits thousands joules of energy in few milli seconds but only a part of that energy is utilized by chromium ions while rest of the energy heats up the apparatus. A cooling temperature is provided to keep The experimental set up at normal.

Working

The energy level diagram of chromium ions shown in figure

The chromium ions get excitation into higher energy levels by absorbing of 5600\AA of wavelength radiation. The excited chromium ions stay in the level H for short interval of time. After their life time most of chromium ions are de-excited from H to G and a few chromium ions are de-excited from H to M.



The transition b/w H & M is non-radio active transition. i.e. the chromium ions gives their Energy to the lattice in form of heat. In the meta stable the life time of chromium ions is 10^{-3} sec. The life time of chromium ions in meta stable state is 10^5 times greater than life time of chromium ions in Higher state

uses

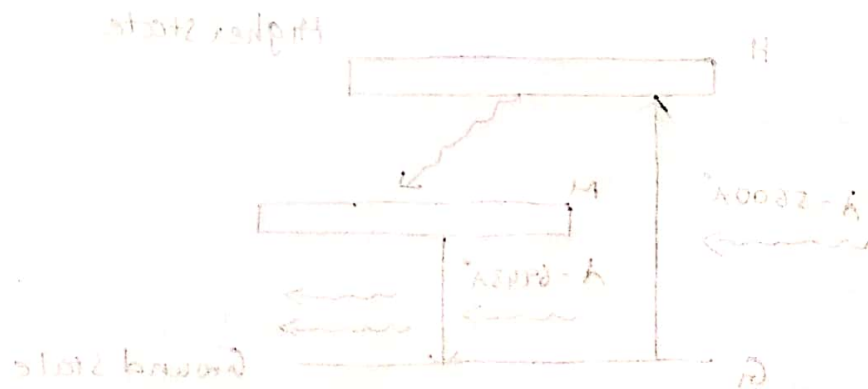
1. In optical photography
2. To remove melanin of skin
3. For recording of holograms

Drawbacks

→ Laser requires high pumping power

→ A pulse laser

→ Efficiency is very small



The transition from H to M is non-radiative. The transition from M to G gives their energy to the lattice in form of heat. In the laser, the life time of the excited state is 10^{-8} sec. The life time of the ground state is 10^{-10} sec. The life time of the excited state is much greater than the life time of the ground state. This is the reason why the laser is not a steady state.