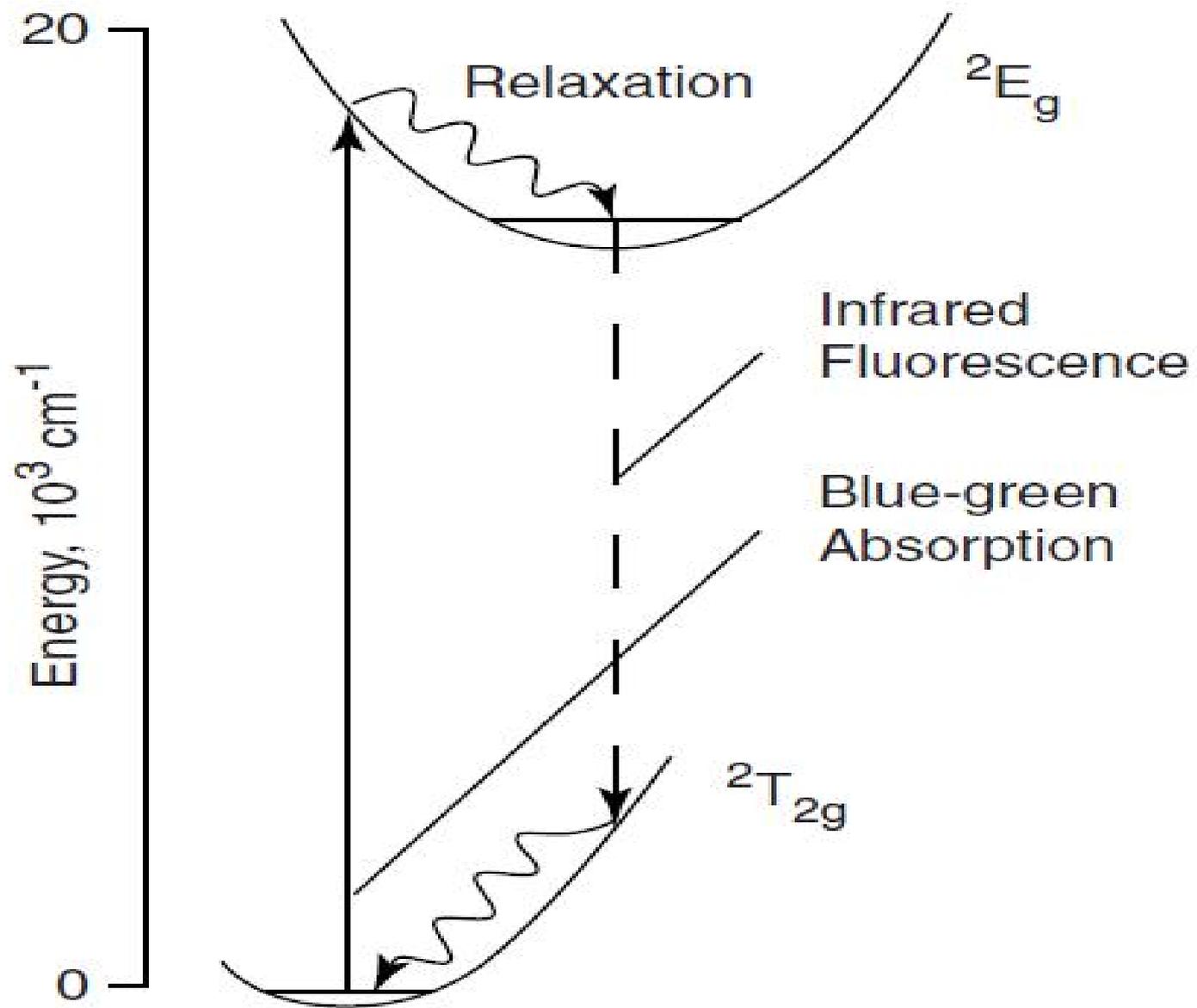
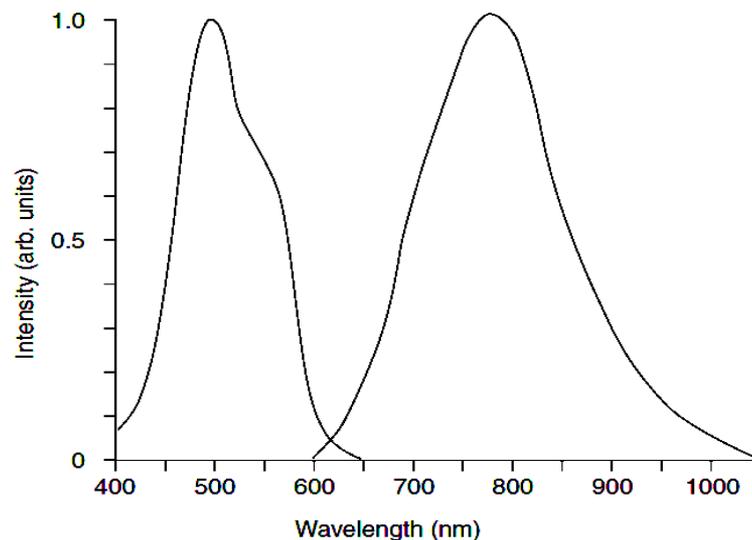


## Ti : Sapphire LASER

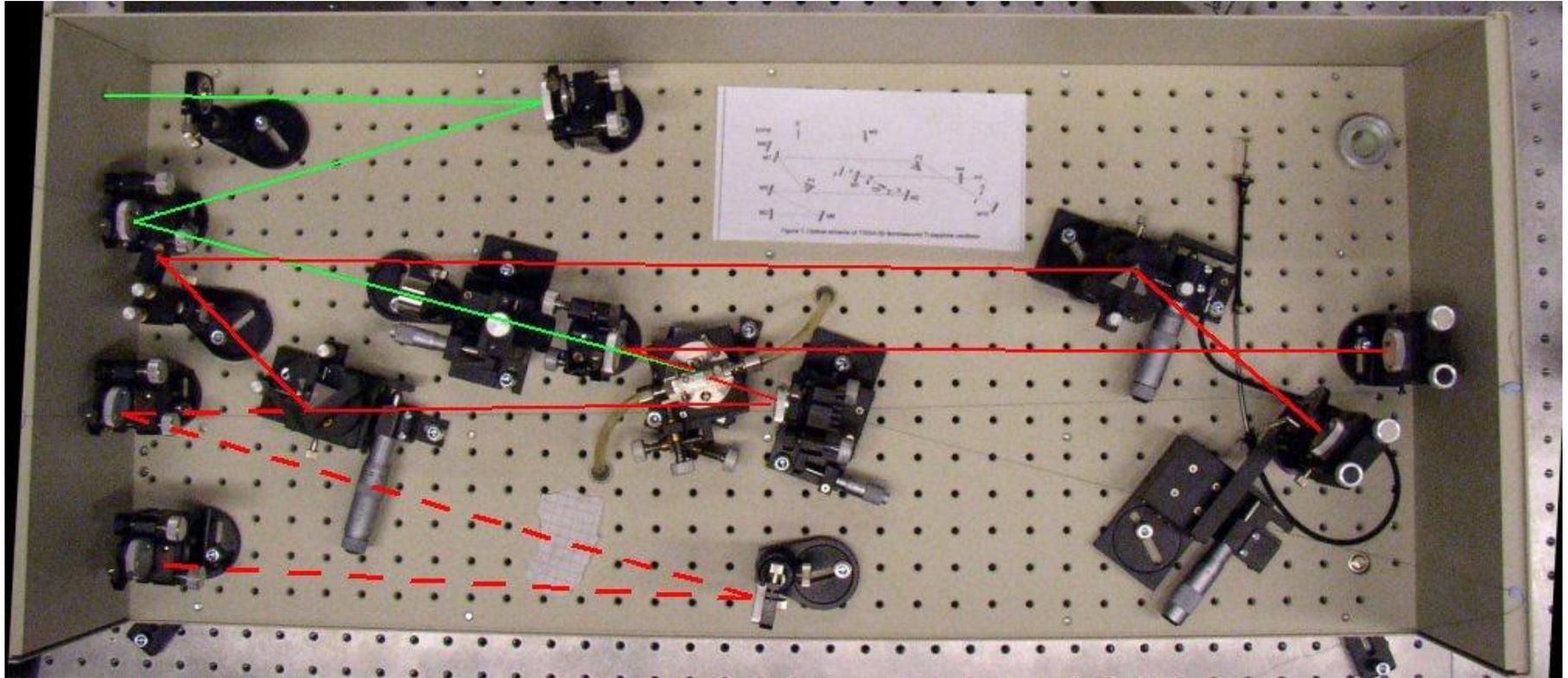
- Ti : sapphire lasers are tuneable lasers which emit red and near-infrared light in the range from 650 to 1100 nm.
- Ti : Sapphire referred to active medium which comprises of a crystal of Sapphire ( $\text{Al}_2\text{O}_3$ ) doped with Titanium.
- The  $\text{Ti}^{3+}$  ion is responsible for the laser action.
- The electronic ground state of the  $\text{Ti}^{3+}$  ion is split into a pair of vibrationally broadened levels.



- Absorption transitions occur over a range of 400nm to 600 nm wavelengths, only one is shown.
- Fluorescence transitions occur from the lower vibrational levels of the excited state to the upper vibrational levels of the ground state.
- Lasing action is only possible at wavelengths longer than 670 nm because the long wavelength side of the absorption band overlaps the short wavelength end of the fluorescence spectrum.

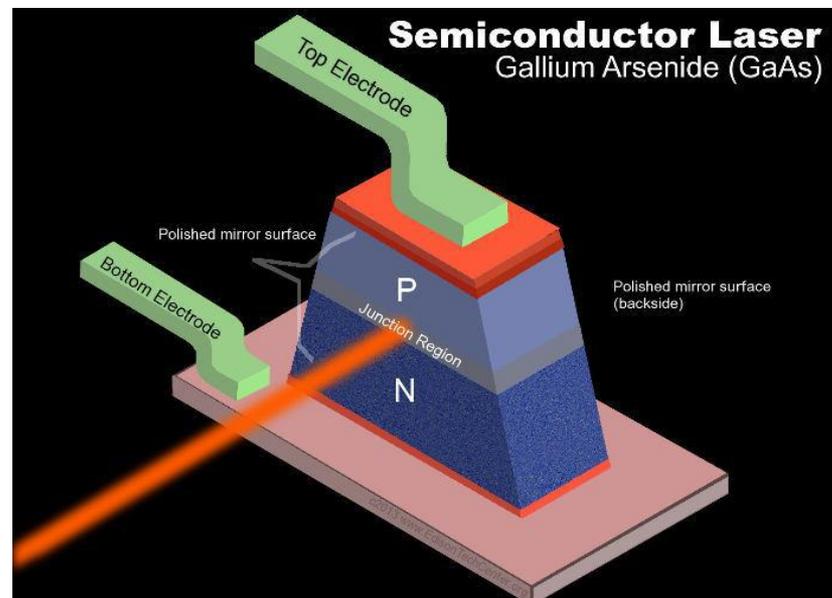
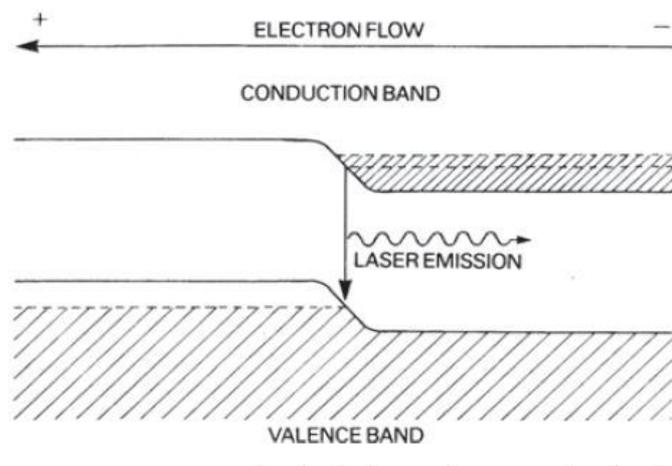


# Laser : Fundamentals and Applications



## Semiconductor LASERs

- By applying an electrical potential across a simple diode junction between p- and n-type crystal, electrons drop down from a conduction band to a valence band, emitting radiation in the process.



- Emission is mostly in Vis-Infrared region.
- Extremely small in size.
- Poor beam quality and poor collimation.
- Available as both tunable and fixed wavelength.
- Gallium arsenide lasers emit at a wavelength of around  $0.904 \mu\text{m}$
- The so-called 'lead salt' diode lasers, which are derived from non-stoichiometric binary compounds of lead, cadmium and tin with tellurium, selenium and sulphur, emit in the range  $2.8\text{-}30 \mu\text{m}$ , depending on the exact composition.
- Requires low operating temperature, and can be tuned by varying the temperature.
- Modes in a diode lasers are typically separated by  $1\text{-}2 \text{ cm}^{-1}$
- Individual mode has a very narrow linewidth, of  $10^{-3} \text{ cm}^{-1}$  or less.
- The output power of continuous semiconductor lasers is generally measured in milliwatts, but can be increased upto 10 W.

## Atomic and Ionic Gas LASERs

- Active medium is a gas which is either monatomic, or else it is composed of very simple molecules.
- Laser emission occurs due to transitions in free atoms or molecules, usually at low pressures, the emission line width can be very small.
- The gas is often contained in a sealed tube, with the initial excitation provided by an electrical discharge.

## Helium – Neon LASER

- First Continuous Wave laser ever constructed.
- The active medium is a mixture of the two gases He & Ne in a glass tube.
- Partial pressure of helium is approximately 1 mbar and that of neon is 0.1 mbar
- The initial excitation is provided by an electrical discharge and serves primarily to excite helium atoms by electron impact.
- Certain levels of helium and neon are very close in energy, excited helium atoms subsequently undergo a process of collisional energy transfer to neon atoms, very efficiently.

# Laser : Fundamentals and Applications

