PHY 201 2022

ND-YAG LASER

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INDEX

ND-YAG LASER PARTS/ COMPONENTS OF

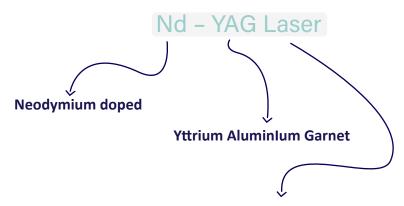
PROPERTIES CONSTRUCTION OF ND - YAG

CONSTRUCTION OF ND - YAG

WORKING LASER OUTPUT

15 APPLICATION

ND-YAG LASER



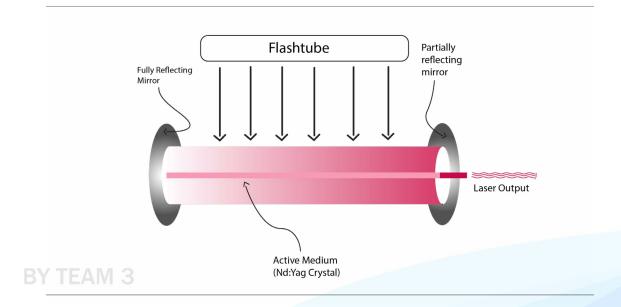
Light amplification by stimulated emission of radiation

- Nd-YAG laser is a solid state laser in which Nd YAG is used as a laser medium.
- It has four energy level involved in system.
- Its working principle is such that when optical pumping is provided to the device. Then the Nd ions get raised to higher energy levels and their transition produces a laser beam
- This laser generally emits light of wavelength of nearly 1.064 μm.

PARTS/ COMPONENTS OF LASER

 Nd - YAG laser consists of three important elements: an energy source, active medium, and optical resonator.

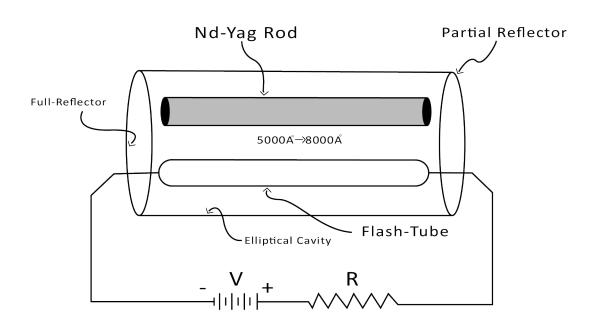
DIAGRAM 0.1



PROPERTIES

- Yttrium Aluminium Garnet (YAG) Y3Al5O12 best choice of a host for neodymium ions (Nd)
- YAG offers low threshold and high gain
- YAG is a very hard, isotropic crystal
- good thermal and mechanical properties
- can be grown and fabricated in rods of high optical quality

DIAGRAM 0.2



CONSTRUCTION OF ND - YAG LASER

1.ENERGY SOURCE

 The energy source or pump source supplies energy to the active medium to achieve population inversion. In Nd: YAG laser, light energy sources such as flashtube or laser diodes are used as energy source to supply energy to the active medium.

2.PUMPING MECHANISM

 Optical PumpingOptical pumping is a process in which light is used to raise atom from a lower energy level to higher energy level. 3.PUMPING SOURCE

 xenon flash lamp photons from the flash of flash lamp excite nd3+ ions to higherexcited levels to create population inversio

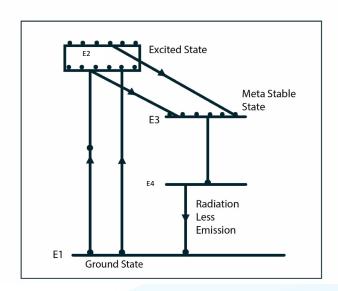
4. ACTIVE MEDIUM

- The active medium is a collection of atoms or molecules, which can be excited into a population inversion situation, and can have
- electromagnetic radiation extracted out of it by stimulated emission.
- The active medium can be in any state of matter: solid, liquid, gas or plasma.
- The Nd-YAG laser's active medium is a crystal of yttrium, aluminium, and garnet doped with neodymium ions. Nd3+ ions act as Active centres in the active medium

4.OPTICAL RESONATOR

- The Nd-YAG crystal is placed between two mirrors. These twomirrors are optically coated or silvered.
- Each mirror is silvered or coated differently. One mirror is fully silvered whereas, another mirror is partially silvered. The mirror, which is fully silvered, will completely reflect the light and is known as fully reflecting mirror.
- On the other hand, the mirror which is partially silvered will reflect most part of the light but allows a small portion of light through it to produce the laser beam. This mirror is known as a partially reflecting mirror.

DIAGRAM 0.3



WORKING

 When the flash tube this switch on electron in ground state E1 of Nd3+ ion go to higher energy level E2 by stimulated emission.

- As E2 is unstable excited state life time of electron in E2 is very less. So, electron in E2 go to energy level E3 rapidly by spontaneous emission.
- As E3 is metastable state. It is population very soon and does population inversion is achieve between E1 and E4.

 Now when external photon is insider electrons in E3 go to energy level E4 by stimulated emission.

- During the stimulated emission from E3 to E4 light amplification also take place and so, the light produced is laser.
- The electron in energy level E4 goes to ground state E1 by spontaneous emission.

LASER OUTPUT

- In the form of pulses of variable repetition high rate
- Overall efficiency 0.1 to 1% range
- Can be pumped by a diode laser (GaAs) for high efficiency

APPLICATION

MILITARY

- Nd YAG lasers are used in laser designators and laser rangefinders.
- A laser designator is a laser light source, which is used to target objects for attacking.
- A laser rangefinder is a rangefinder, which uses a laser light to determine the distance to an object.

MEDICINE

- Nd: YAG lasers are used to correct posterior capsular opacification (a condition that may occur after a cataract surgery).
- Nd YAG lasers are used to remove skin cancers.

MANUFACTURING

- Nd YAG lasers are used for etching or marking a variety of plastics and metals.
- Nd YAG lasers are used for cutting and welding steel.

SOURCES:

- https://www.slideshare.net/jaydipkanpariya1/ndyag-laser-working-and-construction
- https://www.physics-and-radio-electronics.com/physics/laser/ndyaglaser.html
- https://www.physics-and-radio-electronics.com/physics/laser/ndyaglaser.html?hl=en_US