

Information technology meets physics

By Sebastian Graf and Jens Waldecker

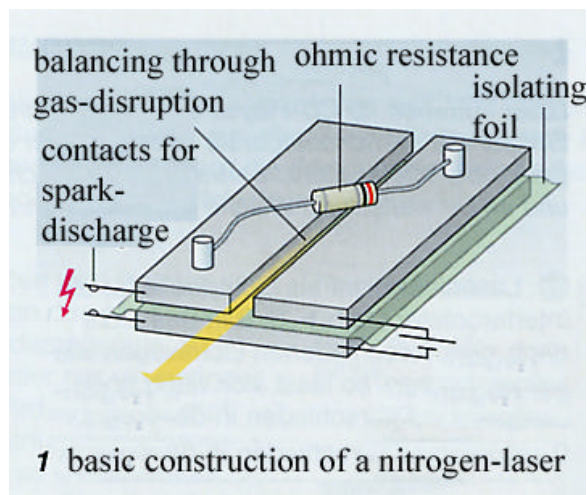
The Laser

The Laser-technique (Light amplification by stimulated emission of radiation) is based on the physical existence of meta stable states in which electrons exchange into an energetic advantageous state. The reasons for this exchange are either a long retention period or outer influence.

Today those states are achieved by the use of determined gases, semiconductors and some crystal-structures. Often used for laser-light generation is nitrogen-gas. In that type of lasers the nitrogen-molecules are stimulated by a gas-discharge to reach a higher energetic level. This means, that electrons of the nitrogen-gas are lifted up to a higher "orbit". In such a meta-stable system the average retention period of an electron is much more higher than in a stimulated stable system, like it is used in fluorescent tubes. A randomly generated photon is shot through the gas and causes the emission of other photons. These new photons are emitted when the electrons return to their original energetic level. They all have the same wavelength and phase because all electrons in this system have to surmount the same distance due to discrete energetic levels (quantum mechanic).

After one nanosecond all molecules are in their original state.

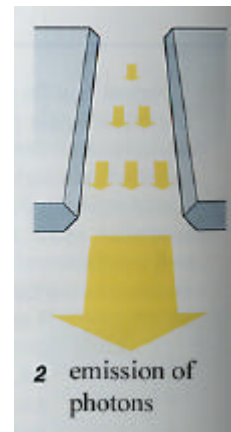
The nitrogen-laser



causes a spark-discharge at the contacts. This takes the same effect as an alternating voltage to the condenser. The ohmic resistance effects a difference in voltage and charge between the two upper plates which is balanced through the gas-disruption. (picture no2) The gas-molecules are stimulated because of this process and emit a short laser-impulse. The laser's wavelength spans the ultraviolet area and depends on the used gas.

Picture no1 shows the basic construction of a nitrogen-laser (can also work with air cause of nitrogen rate of 78% in the earth-atmosphere).

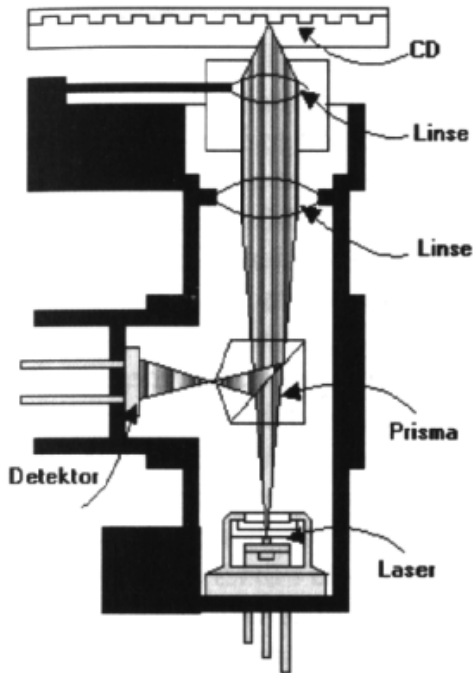
This type of laser consists of a plate-condenser with an isolating foil between the two plates. One of them is split into two parts which are connected to each other by a high ohmic resistance. A high voltage power source is connected to the plates which



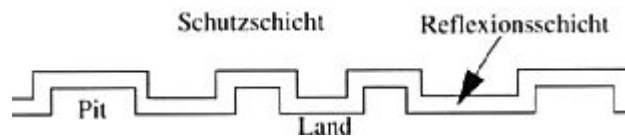
Application of laser technology

Lasers are used in cd/dvd systems, printers, bar code scanners, biological cutters, metal processing, measuring instruments, land survey, environment protection, information transmitter in communications engineering and 3-dimensional surface scans.

We'll concentrate on the CD-technique:

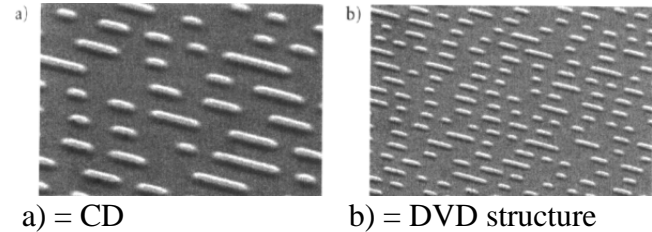


This is obviously the most popular application of laser-technology!



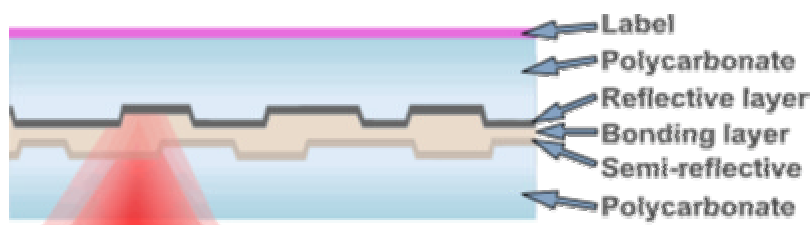
The cd consists of “pits” and “lands”. If the laser-light hits a pit the light is diffused whereas the light is reflected when it hits a land-zone. This reflections can be detected by a photo-detector.

The difference between the cd and the dvd-technique is based on the density of pits and lands:



Special properties of the dvd-technology

A dvd can consist of two layers, so it reaches double amount of storage place. These ones are called dual-layer-dvds (DVD-9 single sided and DVD-18 double sided).



As shown in the picture above the first layer is semi-reflective, so the reading device can decide, which layer it has to read and focus on this one.

The Dual sided technology writes this structure to both sides of the dvd. The disadvantage of these dvds is the impossibility of labelling.

Sources:

www.dictrronics.co.uk

www.siegert.informatik.tu-muenchen.de

diverse physic-books