

# FABICATION AND ANALYSIS OF CNC LASER ENGRAVING ON DIFFERENT MATERIALS

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## ABSTRACT

Engraving is special art of carving of design on harden surface. It is advance and recent technology which uses the laser to imprint shapes and designs on materials what you needed to engrave. Basically it used for industrial applications like in schools, small scale business and hobbyists. Laser engraver works on directing the High Power Laser beam through optic on materials. In laser engrave method two ways one is by cutting material and other is without cutting by simply changing the color. A commercial laser beam is utilized for engraving materials would follow G-Code and M-code program of the pattern followed by the CNC movement control system to cut on to the material. The high intensity laser beam is deliberated on the material surface, it is then burns, melts, or vaporizes and gives high quality surface finish.

In present work the CNC LASER engraving is used to engrave for different materials like wood, aluminium and sheet metals and also composites has been conducted. There are several parameters such as Intensity of Beam, cutting depth and impregnations are used. From this work wood material gives best engrave on material surface for the depth of 1 mm and high quality surface finish.

## Keywords:

CNC LASER engraving, LASER engraving machine, Engrave, G-Codes and M-Codes

## 1. INTROUCTION

In the year 1965, for the first time a hole is drilled on diamond dies by using laser cutting machine. In 1967, The Western Electric Engineering Research Center invented British pioneered laser-assisted oxygen jet metals cutting machine [1].

In general word "LASER" means "Light Amplification by Stimulated Emission of Radiation". The question is how does laser light cut through a steel plate. The laser beam is a column of very high concentration light, of a single wavelength and color. The intense laser beam goes through a nozzle bore exactly before it hits the plate. Due to

high power density results in fast heating, melting and fractional or complete vaporizing of the material.

There are mainly three types of laser machines: i) The CO<sub>2</sub> laser which is best for cutting, boring, and engraving, ii) The neodymium (Nd) and neodymium yttrium-aluminium-garnet (Nd:YAG) lasers. The Nd:YAG laser is used for boring and engraving where very high power is needed. For welding operation CO<sub>2</sub> and Nd/Nd: YAG laser both can be used [1]. In addition other micro jet laser is a water-jet guided laser is used to perform laser cutting functions while using the water jet to guide the laser beam, through total internal reflection. The main advantages of this type laser are that the water also removes debris and cools the material. Additional benefits over traditional "dry" laser cutting are high dicing speeds, parallel kerf, and unidirectional cutting [2]

In CNC laser cutter, according to desired part shape, the laser head cutting is moved over the metal plate and cutting the part out of the plate. In cutting process a capacitive height control system maintains a very accurate distance between the end of the nozzle and the plate. This distance is essential, because it determines where the focal point is relative to the surface of the plate. Some time the Cut quality can be affected by raising or lowering the focused focal point from just above or o or below the surface of the plate. Laser diodes are made by sandwiching negatively i.e. n-type semiconductor with positively i.e. p-type semiconductor. The laser beam produced is only in border layer of the forward biased semiconductor diode. This layer size, mirrors are only few micrometers and are fixed to make very compact diodes. Special colors of diode can be made by changing the choice of semiconductor and the dopant used. Gallium arsenite is the major component in p-type and n-type semiconductors.

## 2. LITERATURE REVIEW

Literature review provides the scope for the present study. Lin li et al [4] conducted experiment on high-power diode laser applications for materials processing. They found that the surface finish is better; less heat affected zone (HAZ), improved beam absorption, recovered morphological characteristics, smaller amount of cracks and less porosity production. They also identified drawback of the high-power diode lasers consist of high beam divergence beam absorption dependent on work piece colors and the difficulty to produce very high-peak-powered short pulsed beam directly. Leone et al [5] examine the effect of the

process parameters on the material removal rates by engraving panels made of different types of wood using a Q-switched diode-pumped Nd:YAG green laser. They found that the mean power, the pulse frequency, the beam speed and the number of repetitions are strongly affects on the engraved depth. They also determined that a reduced frequency range and the maximum output power have been achieved by increasing the speed of engrave. Depends on the mean power the maximum speed necessary to obtain linearly engraving is possible. Leone et al [6] experimentally investigated that AISI 304 stainless steel marking by a Q-switched diode pumped Nd:YAG laser. The result shows that, both surface roughness and oxidation greater as a function of frequency, resulting in an enhancement in contrast, up to a typical value, decreasing afterwards.

From the above literature it has been found that still there is scope to investigate the engraving of different material by using Diode laser engrave machine. In present study, we have taken different materials like aluminum sheet, different type of wood, composite material.

### 3. EXPERIMENTAL PRODUCER

In present work a CNC diode laser engraving machine is fabricated as show in fig 1.

**MACHINE SETUP:** The machine works with the help of the mechanical system, electronics system and the program file making is using CAD/CAM software.

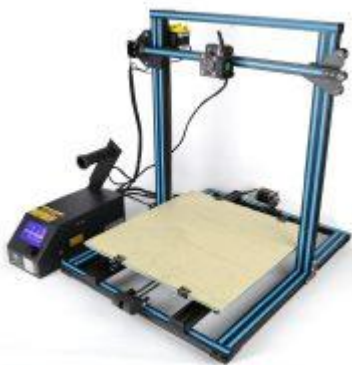


Fig1. Diode laser engraving machine

First step is to generate a program file using CAD/CAM software. There is also another option of manually writing the program file. To interface with Smartphone the Bluetooth is connected to the microcontroller and the USB connection can be used to connect with PC or laptop. In this project, laser cutting CNC machine considered as the greater machining system to their precision work. For any types of laser engraving CNC machine, the axis of motion are naturally X and Y axis. For the machine operate included with Z axis motion, the cutting head may be controlled. The laser cutter not at all makes physical contact with material. Ultimately, there is less possibility for the material injured and the surface finish of material cuts is high performance. The gantry sort uses less material, thus is

more affordable to construct. Our intention is to make lesser and cheaper CNC machine, which will also be portable.

### SOFTWARE: RD WORKS

**LASER ENGRAVING SYSTEM:** Laser engraving cutting system achieves successful control through a computer numerical, according to the user's different requirements of the completion of processing tasks. The system is included with control board and control panel, and supporting software. This user manual describes how to use the software to complete the task of laser processing.

### Software Supporting File Formats

Vector format : dxf, ai, plt, dst, dsb...etc.

Bitmap format : bmp, jpg, gif, png, mng...etc.

### ENVIROMENTAL REQUIREMENTS

- Windows 2K/XP/Vista, win7, XP recommended.
- Above CPU586, above PIII or PV recommended.
- Memory, above 1G recommended

### 4. RESULTS AND DISCUSION

The machine was fabricated successfully and during testing it worked well with the Bluetooth as well as with the USB connection. Most of the commonly available CAD/CAM softwares were supported and the machine proved to do 2-D. The Fabrication of this CNC Router with Bluetooth connectivity was cheaper than many commercially available CNC routers.

There are different materials are used to engrave by using CNC diode engraving machine as shown in below figures.

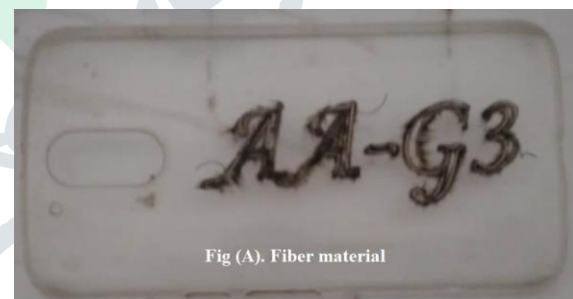


Fig (A). Fiber material

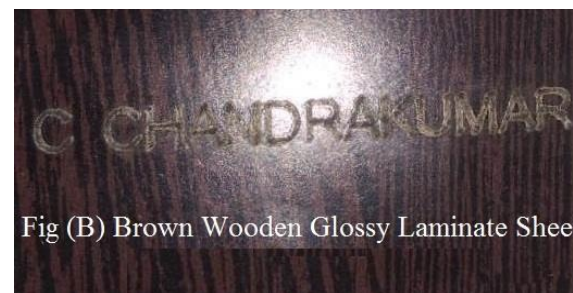


Fig (B) Brown Wooden Glossy Laminate Sheet





Whereas incase teak wood the surface finish and shape of image engraved was excellence. Since teak wood is soft and smooth material and the high power focused laser light burns the teak wood very faster rate as shown in fig (C). But it can be noticed that engraving of any images in light color wooden glossy laminate material was very clearly identifiable by changes in the color of engraved portion. During the engraving process high temperature was produced which in turn it changes the color of the image as compared to with brown wooden glossy laminate material as shown in fig (B) and (D).

## 5. CONCLUSION

The conclusion was drawn with reference to the above results and discussion is as follows

1. The intensity of laser light is place a major role and is depend upon the type of material used for engraving.
2. The depth and width of the cutting is based on intensity of laser light and height with which the laser beam is focusing.
3. It is a more rapidly and more precise method when compared with traditional methods. Understanding various setting information on how the process works, in addition knowing a few actions will help you create good engraving product.

## 6. REFERENCE

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Fig (A) represent engrave of latter on fiber material. It is clearly show indicates how the shape and finish was obtained from CNC engraving machine. Here the surface finish was not clear visible due high power intensity of laser light edges of fiber material melts fast along with depth of cutting. Due to which the quality of surface finish was not obtained as compared with other material