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LÉZER GRAVÍROZÁS TECHNOLÓGIÁJA

LASER ENGRAVING TECHNOLOGY

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Abstract

The thermal cutting processes have come a long way in the last decade, but we still don't use the wide application variety for the laser equipment. Nowadays laser cutting is very popular and is one of the most widely applied technology in car industry too. Our goal is to introduce the laser engraving technology.

***Keywords**: engraving, laser engraving, laser*

Összefoglalás

A termikus vágási eljárások jelentős fejlődésen mentek keresztül az elmúlt évtizedekben, azonban a lézergépek sokoldalúságát közel sem használjuk ki. Manapság a lézervágás nagyon elterjedt és az egyik legszélesebb körben alkalmazott technológia az autó iparban is. Célunk az, hogy bemutathassuk a lézeres gravírozás technológiáját.

***Kulcsszavak:** gravírozás, lézergravírozás, lézer*

Introduction

Nowadays the laser technology is very common and available. This new technology is useful for thermal cutting, engraving and for other laser material working. The first application of the laser equipment was the thermal cutting in case of metals. This technology is known well also the technological parameters are ready for many metals, polymers and composites.

1. The Laser technology

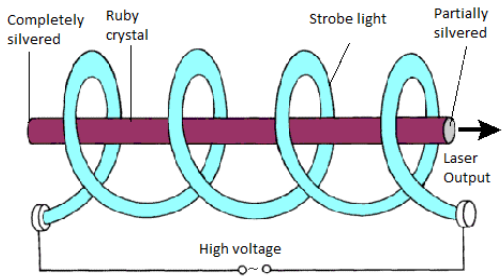
The word LASER is an English acronym word (Light Amplification by the Stimulated Emission of Radiation). So for the laser to operate it is necessary that the stimulated emission to dominate and the light to be strengthened by it. [1]

The first laser was developed by the American Theodore Maiman in 1960. The prototype's material in which the laser effect played out was a ruby crystal (Al_2O_3 crystal with Cr_2O_3, which has an appropriate metastable energy level), and for excitation he used a strobes light. The ruby crystals 2 ends had a semipermeable and a highly reflective mirrors layers were evaporated ***fig. 1.***

When the strobes lights excites, the ruby crystal and the metastable energy level light is created which starts the laser emission

that is reflected back and forth along the axis. Since there is no mirror on the side of the ruby, the multiple reflections clears out the divergent rays and only the strictly parallel rays with the axis of the crystal stays in the system.

When the lights energy surpasses the level which can escapes the semipermeable mirror, the laser lights up. Because of the geometrical layout of the system the exiting rays are very parallel and the divergent is negligibly small [2].



1. figure. *Ruby Laser Schematics [1]*

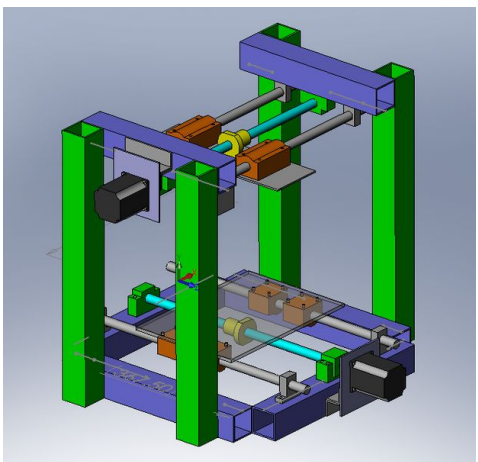
2. Laser advantages for engraving

- The engraving tool (laser beam) doesn't wear off;
- Laser engraving uses a light beam that's why none of the parts of the machine doesn't touch the machined material;
- There is no need for a special tool to lock the workpiece in place and there are less consumable items used by the Epilog laser system;
- Laser engraving is definitive and precisely engraves pictures and markings up to 3050 points/cm density too;
- There is nothing similar to the level of reproduction that the laser engraver can achieve;
- The laser can be a fast solution to processing. If we want to process several workpieces with the laser system, then we can easily make a jig to lock the workpieces and put that under the machine. Also we can process as many pieces as it fits on the engraving table [3,4].

3. Laser Engraving technologies

While engraving with laser the material is either burned off or evaporated by a concentrated ray. With this we can create a visible and readable label, logo, picture, serial number or even a bar code to almost any material.

The application (**fig.2.**) of it is really widespread. It is used most frequently to create souvenir, but in industrial areas engraving is used to put on the brand and numbering tools or components. Thanks to the features of the laser we are able to use it on small surfaces with high precision [3].



2. figure *Arduino Laser Cutter/Engraver.*

3.1. Deep engraving

Deep engraving is the removal of multiple layers. The laser beam penetrates the surface and removes the material along its path by melting and blowing away the molten material or by evaporating it.

The laser engraving implies a high temperature which causes the removal of the material. When the local temperature surpasses the material's melting point it causes melting.

When the material solidifies the modified surface is formed as a marking the high contrast like in laser toning or etching is not achieved by engraving because we evapo-

rate and blow away the material in the process one example showed in **fig. 3.** For wood we use a Q-switch diode pumped double frequency Nd: YAG green laser to avoid carbonization [3].

3. figure. *Deep Laser Engraving in Brass for Elevator Buttons.*

3.2. Ablation

During the ablation process, the top (covering) layer is evaporated by the laser beam (example **fig.4**.). When ablating the top layer of coated metals, the laser beam does not interact with the base material, but only with the coating layer.

4. figure. *Laser Ablation.*

Very thin layers such as colour and/or anodizing layers are especially suited for laser engraving.

High contrasts can be achieved with a small amount of laser power since these layers absorb laser radiation extremely well.

Examples are: anodized aluminium laser marking foils [5].

3.3. Annealing

A contrasting mark can be created using an annealing effect on metallic materials where the laser beam heats up the metal below its melting point, creating structural changes in the surface, see in **fig.5**.

5. figure. *Stainless Sleeve Laser Annealing.*

The colour of the mark is determined by the maximum temperature attained in the metal, the properties of the metal, and the parameters selected on the laser.

The annealing technique has a unique characteristic in that it produces a contrasting mark without disrupting the surface finish of the metal [5].

3.4. Colour change

During this process, the laser radiation penetrates the material (plastic, stainless steel) and is absorbed by the colour pigments. As a result, the pigments are chemically modified, resulting in a colour change in the material (**fig.6**.). The colour change

achieved depends on both the pigment and the basic material used [5,6].

6. figure. *Colour Laser Marking with FiberCube Laser Marking System*

4. Conclusion

Laser engraving can be suitable for marking and also with deep engraving we can remove material too with it.

It can be an alternative to machining without using tools, by that reducing the cost in long term.

The problems of using laser in engraving and cutting are already known and solved.

To work out the technological parameters of deep engraving several experiments are required. Simulations and calculations need to be done based on the outcome.

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