Laser markable resins, DSM

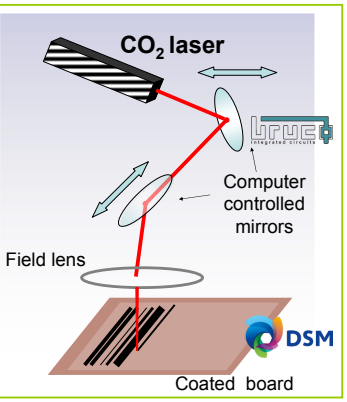
PrintValley

Introduction

Laser marking is a non-contact printing technology based on color change processes induced by laser irradiation of a surface. Compared to other printing technologies such as inkjet, laser marking offers distinct combination of advantages:

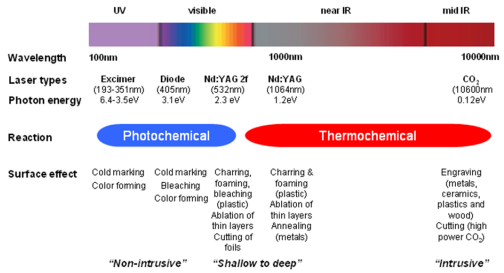
- Suitable for 3D substrates and packed products
- High mark quality and durability
- Clean printing process with low maintenance
- Cost reduction through direct printing and stock elimination (label replacement)
- Absence of waste and consumables (ink or ribbons)
- High marking speed and flexibility (late moment customization)

DSM Coating Resins has done a feasibility for the development of laser markable *resins* within the PrintValley project. The project is executed in cooperation with Bruco Integrated Circuits and Innoluce for design of the required optical module.

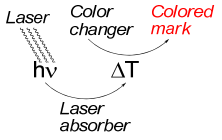


Fundamentals of Laser Marking

Depending on the wavelength of the laser, irradiation of a material by a laser beam either induces a photochemical change (for short wavelengths) or results in heat generation, which may trigger a thermochemical change:



Our laser marking purposes are best met by thermochemically driven processes, since these can be initiated by commonly applied lasers and background discoloration before laser marking can be avoided more easily.

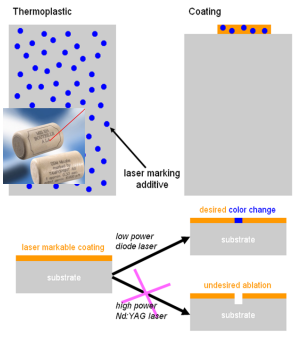


Thermochemically driven laser marking requires the presence of a laser absorber that transforms photon energy into heat plus a color changer that responds to temperature rise by ondergoing a chemical reaction accompanied by formation of colored mark:

Coatings versus Thermoplastics

Compared to thermoplastics, coatings have the advantage that they can be applied locally only on the spot where laser marking is required.

Laser properties should be carefully adjusted to meet the requirements set by the nature of the coating, absorber, and color changer. Since typical commercial coatings are thin (~6 μ), too high powers may lead to damage, e.g. ablation or engraving:



2010 Results: Color Change Resins

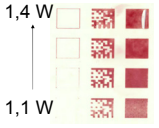
Research focused on a feasibility of incorporating reactive color change monomers in the coating polymer. Advantages of Color Change Resin (CCR) technology are:

- Less migratables due to incorporate in resin and lower cost.
- Effectivit, bringing absorber and colour changer close to each other.
- Organic color change (~200 °C) limiting unwanted thermal damage.

Results: markability at 240 m/min proven with 3W CO2 laser power. Chemical incorporating of components in resin difficult.

2011 Results: Color Change Coating and optical module

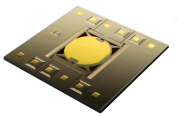
Research focus on two approaches based on incorporating reactive color change materials in the coating polymer to produce a low cost laser markable system for bulk applications.

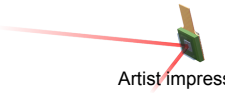


Effect of laser power on color change

Marking color change coating 1,4 W C02 laser, 18 m/min

Results:
- Transparent to red color change proven, at low laser power of 1,4 W CO2 laser power
- Gas formation during laser process (overheating)
- Not completely thermal / time stable (52 C).
- Commercial feasibility under discussion, due to specific (non-bulk) chemicals required.





Artist impression of optical module

-The first prototype of a 1D-mirror and the controlling electronics will be ready by the end of August

Conclusion

The project has shown:

- Technical feasibility of the laser markable resin concept; for a red colour – but theoretically this can also be done with different colors
- Constraints in operating window of the marking process
- Customer interest, but also specific/ high requirements on contrast and freedom in formulation of the resin / coating.
- Technically feasibility of required optics in progress

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