# A NEW THERMOSENSITIVE FILM

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Abstract: In continuation of our works concerning digital processes' materials we have developed a «dry» film intended for transparencies' making at the laser systems equipped with IR-laser sources having wavelengths from 0,85μm to 10,6μm. The film consists of a polyester base on which a polymeric layer having a low thermal stability is coated. The image recording on such a material is a result of laser ablation of a thermosensitive layer. The resulting transparency needs no additional treatment. The high optical density of the initial polymeric layer, the low minimal density and the high edge sharpness allow such transparencies using for photopolymeric platemaking in letterpress as well as for conventional offset platemaking.

## Introduction

Any optical recording system consists of radiation source, controlling device and recording layer.

The recording layer is the very part of the system where physical and chemical processes of the end visual image formation are taking place.

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For a few decades *R* and *D* works have been attempted concerning silverless photosensitive materials' creation.

Many organic and inorganic layers possessing high resolution and other good characteristics have been developed but their photosensitivity was unsatisfied. The wide application of laser radiation sources in output devices had stimulated the «second wave» of silverless materials' *R* and *D*. These layers' low energetic sensitivity may be compensated for a high power density and a narrow spectral area of laser radiation. That is why such silverless materials may be applied for laser recording with rather high rates and resulting in a good satisfied image quality.

After image recording such layers coated on transparent polyester bases as usual need no additional treatments thus allowing to have an economic and ecologically pure «dry» technological process of transparencies' making.

Though the problem of dry films' development may be considered as unnecessary one in the period of a low but steady computer-to-plate technology introduction nevertheless the leading companies propose a lot of such materials for graphic arts.

Unfortunately none of them are available for our customers yet. So our company had attempted its investigations. The results of our works concerning digital materials and the analyse of available information show that the most perspective layers for laser recording may be so-called D-in-P-combinations namely fine dispersions of dies or pigments in a suitable polymeric binder. Such a layer coated on a transparent base becomes a real substrate for a laser beam effect.

This effect results in the ablation of the recording layer from illuminated areas thus forming an image.

The laser induced ablation process can be considered as a three-step process. The first step involves the absorption of laser energy by the dye contained in the recording film; the second step involves the conversion of the absorbed energy into heat (via non-radiative decay processes of the dye); and the third step involves the melting and flow of recording material to form a mark. The write-sensitivity of a recording film is a device parameter that is inversely proportional to the minimum or threshold energy required to create a mark in the film.

It was shown that the write-sensitivity of D-in-P optical recording films is governed primarily by the optical efficiency of the film. The optical efficiency of the film is a parameter which depends on the dye concentration, the dye absorption coefficient and the film thickness.

In selecting dyes it is important to consider their photophysical properties along with the more obvious characteristics such as absorption wavelength, absorption coefficient and theirs thermal and photostability.

The required high absorption efficiency may be achieved by using a comparatively thick film or one with a high dye concentration. Excessive dye loading, however, may lead to aggregation of dye molecules and ultimately to microcrystallization, which will reduce film quality; on the other hand, increasing the film thickness may reduce the write-sensitivity. It was also shown that the physical properties of the polymeric binder play no significant effect on the write-sensitivity and thus selection of a suitable polymeric binder should be less demanding, and directed primarily toward those materials with the best film forming properties and those which are compatible with the selected dye.

To be suitable for the optical recording and the following platemaking «dry» films as well as conventional ones must satisfy a few demands:

- a high sensitivity to the laser radiation of a chosen wavelength;
- a high contrast;
- a high $D_{max}$ and a low $D_0$;
- an edge sharpness;
- a high resolution;
- a low linear deformation.

## Results and discussion

The new thermosensitive film consists of two layers coated consecutively on a polyethylenterephtalate base. The first layer affords the adhesion of the upper coating towards the base and simultaneously reflects the IR-radiation.

The top layer is an energy sensitive and imaging one. Its thickness is about 2μm. This layer consists of a dye (or a pigment, for example carbon black) dispersed in a suitable polymeric binder. Due to the high mechanical properties this binary film needs no additional protective coating and has a visible optical density of 5.0 $D_{max}$.

During the exposure the laser beam is absorbed by the dye (or the pigment) particles and results in the ablation of the imaging layer from illuminated parts of the coating. The energetic sensitivity of the layer is about 2 J/cm2. The complicated image formation caused by IR-laser irradiation results in the printing element edge sharpness.

Schematic description of the printing element formation is shown in Figure 1. The upper part of the figure shows the intensity profile of the laser beam; (a) represents the situation when energies well above the recording threshold are used; (b) represents the case when energies near the threshold are employed. $D_0$ is the measured size of the element.

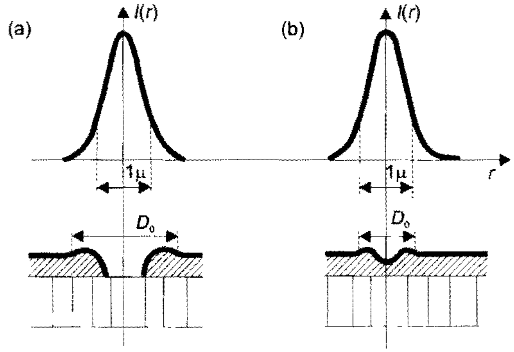


Figure 1. Schematic representation of laser-marked bits in the dye-polymer system. The upper part of the figure shows the intensity profile of the laser beam; (a) represents the situation when energies well above the marking threshold are used; (b) represents the case when energies near the threshold are employed. $D_0$. is the optically measured size of the bit.

The powerful focused laser radiation effect results in the minimal surface tension creation in the hottest point of the melted polymeric layer and a sharp thermal shock pushed the layer substance out of the centre to the peripheral edges of the laser beam mark. Due to the underlayer reflectant properties in practice there is no halo but a sharp edge of the printing element.

## Technological tests

The new film was tested in the process of laser recording using a few output devices equipped with IR-lasers (from 0.85 to 10.6 μ wavelengths). To estimate the film technological properties and its suitability for the following platemaking a set of scales and control elements (lines, halftone and screened) were recorded. In such way received transparencies were instrumentally researched.

Figure 2 shows the profilogramm of the lines recording at different rates.

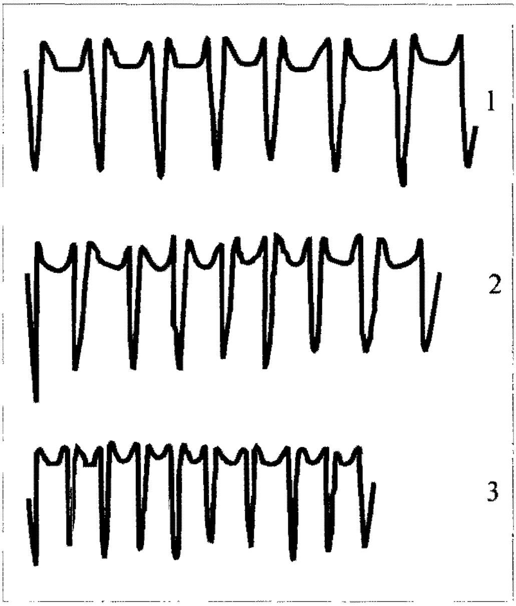


Figure 2. Lines' profilogramms at different recording rates. 1 - 5m/s; 2 - 10m/s; 3 - 15m/s.

Evidently the laser beam effect does not depend on the recording rate so the film energetic sensitivity is probably sufficient for laser recording.

Figure 3 demonstrates the profilogramm of a 12 steps-continuous-tone scale. It is shown that in this case the laser beam effect does not depend on the dot size. The dot profile appearance in this figure confirms the above discussed image element formation.

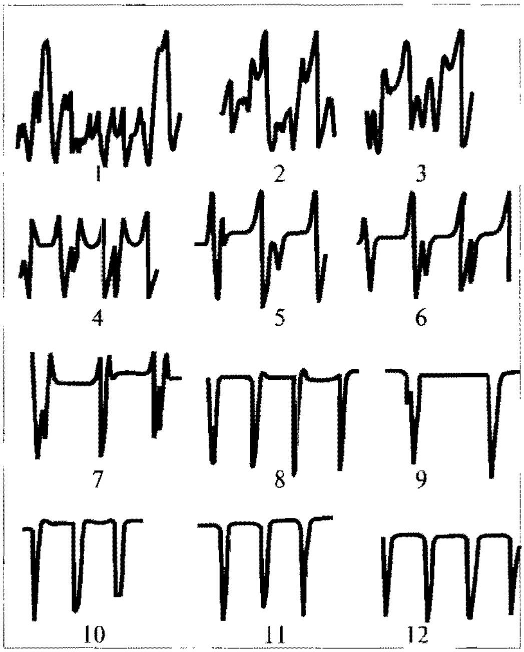


Figure 3. Dots' profilogramms of a 12-steps-continuous-tone scale.

Both Figures 3 and 4 demonstrate the line reproduction accuracy - the recording line size compared to the control element line size are shown at a constant and different recording rates.

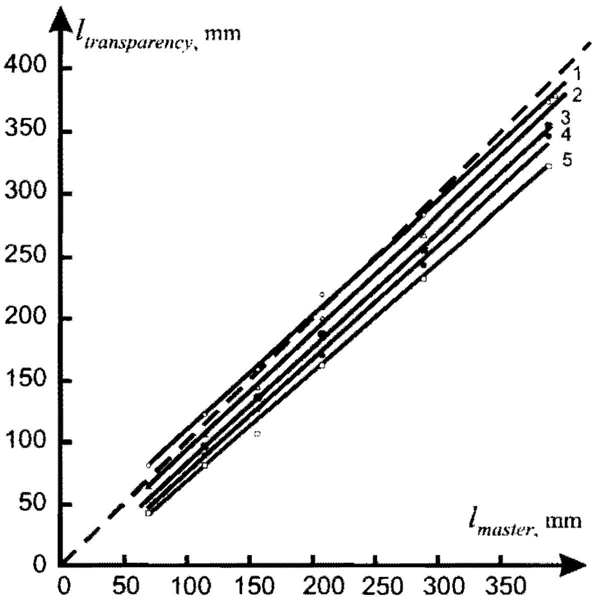


Figure 4. $l_{transp.}$ - $l_{master}$-dependence at different recording rates

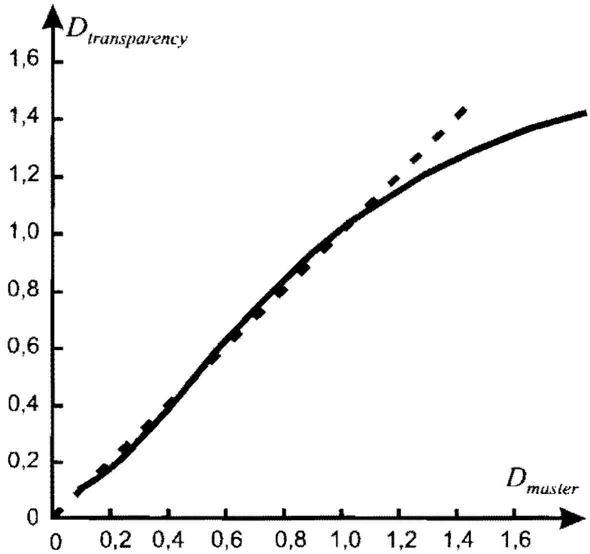


Figure 5. $D_{transp.}$ - $D_{master}$ dependence

These figures confirm the known tendency of elements' negative deformation in the process of laser recording (so-called «cutting»).

A gradation curve or transparency optical density compared to a control element's optical density is shown at Figure 5.

It also demonstrates a good correlation and satisfied properties of the new film.

## Conclusion

The first technological tests had shown that the new thermosensitive film is suitable for recording at laser output devices equipped with IR-lasers. The film meets the general technological requirements.

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