New Thermal Dye Transfer Recording Method by Using an Intermediate Transfer Recording Medium

Katsuyuki Oshima
Dai Nippon Printing Co., Ltd.
Saitama, Japan

Abstract

Current thermal dye sublimation transfer methods required on exclusive receiving layer for printing a dye image. We propose a new thermal transfer recording media(INTM).

The principle of this new process is that the dye image is formed on the receiving layer providing peeling capability on the medium. The dye image is transferred onto the applied object together with the receiving layer. This medium can be applied to various objects without an excellent receiving paper.

The INTM sheets is composed of a protective layer and a receiving layer formed on one surface of the base sheet. These layers can be peeled off from the base sheet. The dye image using an INTM sheet has good durability since the dye image is formed inside the layer under the protective layer. We have also developed a heat-seal layer to enable to various applications. After the heat-seal layer is printed on the dye image in INTM by a thermal head, the dye image in the receiving layer is transferred onto the object together with the heat-seal layer.

The applications include card material (PVC, PET. PC, ABS) and natural paper etc. INTM can be used for card printers, passport printers, seal printers and digital photo printers.

Introduction

Dye sublimation transfer technology has been expanding to its new applications with its quality of high resolution, dry process and quick output image data. The applications include video printer, medical image printer, ID card printer, desk-top publishing output and proofing printer , digital photo printers and so on. The properties of a dye sublimation transfer image with a protective layer are almost equal to those of a silver halide photo image. The disadvantage of sublimation transfer method is the exclusive receiving layer for printing a dye image. We propose a new thermal transfer recording method by using an intermediate transfer recording media (INTM).

INTM Method

Basic theory of formation of the image by using INTM is shown in fig. 1.

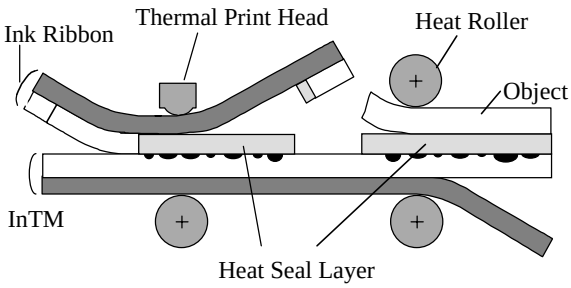

Figure 1. Basic Theory of Formation of the Image using INTM Recording Method

The principle of this new process is that after the dye image is formed on the receiving layer providing peeling capability on the media, the dye image is transferred onto the applied object together with receiving layer. This media can be applied to various objects without an exclusive layer.

Advantages of INTM including the following:

(1) The INTM recording method can form of image onto the various object such as paper and plastic materials as well as card, flat sheets, handout and curved surface.
(2) The INTM recording method can be printed edge to edge.
(3) Using the INTM recording method, the dye image has high durability since it is formed between the INTM and receptor materials.
(4) INTM recording method has a wide range of other many uses. When we separate of the image printing unit and image transfer unit, we are also to apply various kinds of materials by changing the transfer unit.

As shown in a fig. 2, INTM is composed of a protective layer and receiving layer.

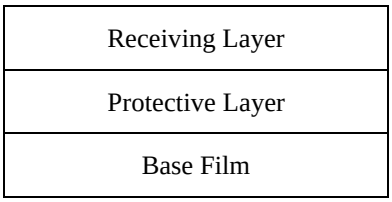

Figure 2. Composition of Intermediate Transfer Recording Media

After the dye image is printed on the receiving layer, the dye image is transferred onto the applied object together with the protective layer and the receiving layer since a protective layer is formed o n the receiving layer, along with the dye image, images using INTM have high durability. In order to produce an image on various materials using the INTM recording method, we proposed heat-seal layer with adhesive property on the various objects. The heat-seal layer is formed by thermal head on the receiving printed the dye image. The heat-seal layer transparent ribbon is monochrome type or heat-seal layer unified film (Y + M + C + heat-seal) shown in fig. 3.

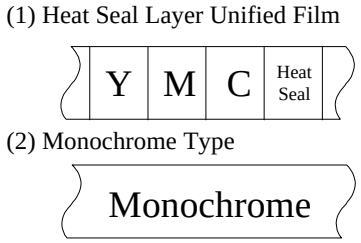

Figure 3. Ribbon Panel Pattern of Heat-seal Layer

The dye image in the receiving layer is transferred onto various objects with a protective layer and a heat-seal layer. Cross section of an image using the INTM recording method is shown in fig. 4

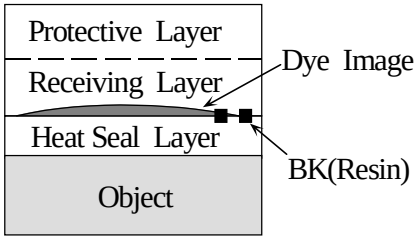

Figure 4. Cross Section of Images Using INTM Recording Method

Card Application

We would like to introduce the actual application using INTM recording method. For card application, the dye thermal printing method is widely being used. Using this method the dye image is printed directly on PVC card. However using the direct printing method, we can print only on PVC cards. Direct printing method can not be applied to uneven surfaces such as IC card and contactless cards. To solve these problem, the INTM recording method is effective. As mentioned, the dye image of the INTM recording method is printed a under protective layer. So the durability of the image using the INTM recording method is similar to that of a direct printed card with protective layer. The result is shown in table 1.

Table 1. Comparison of Durability Between Direct Printing Method and INTM Recording Method.

Items	Condition	Direct Printing Method. (PVC card)		INTM recording Method (PET card)
Light Stability	Xenon 200kJ/m2	Y	63	85
		M	84	90
		C	84	86
Heat Resistance	60°C48hrs.	Good		Good
Humidity Resistance	40°C 90% 100hrs.	Good		Good
Plasticizer Resistance		Good		Good
Chemical Resistance	Water	Good		Good
	Alcohol	Good		Good
	Acetone	Fair		Fair

Light stability was tested by exposing samples to Xenon arc lamp(Atlas Ci-35) through IR inner and soda lime outer filters. Accumulated exposed light energy was calculated from irradiance at 420nm wavelength as kJ/m^2. Residual dye image (%) after exposing 200kj/m^2 Xenon was calculated by following equation.

$$\text{Residual Dye Image}(\%) = \frac{[\text{O.D.}]_n}{[\text{O.D.}]_{\text{initial}}} \times 100$$

$[\text{O.D.}]_{\text{initial}}$: Initial Optical Density (approximately 1.0)
$[\text{O.D.}]_n$: Optical Density after exposure

Light stability of the INTM recording method is better than that of direct printing method.

The heat resistance test was done by keeping samples at 60°C, dry for 100hrs. The humidity resistance test was done by 40°C,90%,100hrs. For the heat and humidity resistance test, no damage happened to either samples. The plasticizer resistance test was done by contacting soft PVC on these images with 70g/cm^2 at 40°C,100hrs. Two samples were discolored. The chemical resistance test was done by rubbing image area of the samples for 30 times with an applicaotor soaked in water, ethyl alcohol and acetone, The samples of the two printing methods had no damage for water and alcohol, but was discolored by acetone.

We propose that a heat-seal layer be used with INTM recording method for card application. Card materials include PVC, PET, PC, ABS and so on. Only receiving layer with dye image of INTM can not be transferred onto all card materials by the heat roll transfer system. Applying

heat-seal layer on the receiving layer with a dye image can be transferred to various cards decrease transfer temperature of the heat roll. Comparison of transfer property with heat-seal layer and without heat seal layer is shown in table 2.

Table 2 Comparison of Transfer Property with Heat-seal Layer and without Heat-seal Layer

Trans-fer Temp.	PVC Card		PET Card		PC Card	
	Without Heat Seal Layer	With Heat Seal Layer	Without Heat Seal Layer	With Heat Seal Layer	Without Heat Seal Layer	With Heat Seal Layer
170•	Good	Good	Good	Good	Fair	Good
155•	Good	Good	Good	Good	Poor	Good
135•	Good	Good	Good	Good	Poor	Fair
120•	Fair	Good	Fair	Good	Poor	Poor

Paper Application

When transferring a dye image onto a natural paper using the INTM, the receiving layer with dye image can not adhere without a heat-seal layer. Test method are shown in Fig.5.

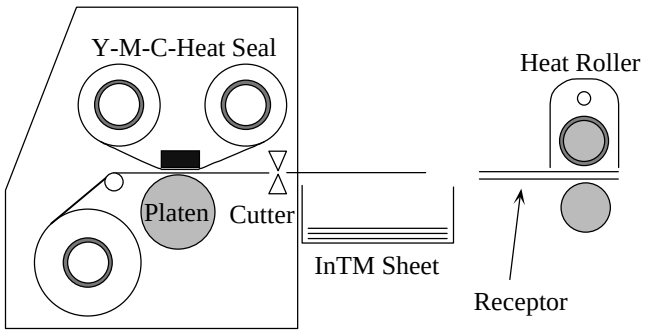

Figure 5. Transferring Method onto Natural Paper using INTM .

The receiving paper was formed to provide peeling capability from the base sheet, which is composed of plastic film, natural paper. Dye image was printed onto the receiving paper using a dye sublimation transfer printer. Next the receiving paper with the dye image was put onto the paper like letters to contact between receiving layer with the dye image and the paper. After laminating the receiving paper and the paper together using a laminating machine, the dye image with the receiving layer and protective layer are transferred onto the paper from the base sheet. Laminating temperature is from 130°C to 140°C, laminating speed is from 0.6m/min to 0.8m/min. The dye image could be transferred onto the rough and smooth paper. Applying the INTM recording method to paper include ID photo, letter set, photo album, proof, passport, bankbook, certificate and so on. There are three types of printing process using transfer technology .

(1) Off-line process : Sublimation transfer printer (single thermal head) + laminating machine
(2) Inline process (single thermal head) : Printing unit onto INTM using single thermal head + laminating unit
(3) Inline process (Multi Thermal Head) : Printing unit onto INTM using multi thermal head + laminating unit

Printing processes are used properly for applied object, system cost and a issue speed.

Conclusion

Using INTM recording method dye sublimation transfer image can be applied to various objects without an exclusive layer. Applying INTM recording method dye transfer recording media will expand to short run printing of digital photo, ID card, official paper and novelty.

References

1. T. Ishida, M..Kutukake and K. Oshima, IS&T's 48th Annual Conference (1994)

Biography

1988 Dai Nippon Printing Co., Ltd. Information media Laboratory working on dye sublimation transfer media

1986-1988 Dai Nippon Printing Co., Ltd. Central Research Institute Research & Development of dye thermal transfer media.

1981-1986 Tokyo Institute of Technology Majored in chemical engineering.