Full Colour Fluorescent Images Printed by Thermal Dye Transfer

Ian R. Stephenson and Richard A. Hann, ICI Imagedata, Brantham, Essex, United Kingdom

Abstract

Conventional Thermal dye transfer printing uses cyan, magenta and yellow (CMY) dyes to build up a full color image. This paper concerns the use of fluorescent dyes to build up a full color image which is virtually invisible under normal illumination, but glows brightly when illuminated with a UV blacklight. In order to obtain the image, the CMY dyeset is replaced by a red, green and blue (RGB) fluorescent dyeset. Unlike other forms of printing, the process employs additive color combination. If the RGB ribbon is used in a conventional printer instead of a CMY ribbon, the image must first be converted to a negative in order to give the correct color values. There are a number of applications envisaged for this process. It can provide an additional level of security on transaction cards, or it could be used for novelty applications.

Introduction

Conventional Thermal dye transfer (D2T2) printing uses a ribbon with yellow, magenta and cyan (YMC) panels to provide a full colour image of the subject through subtractive combination of the dyes transferred from these panels (see Figure 1). Fluorescent dyes may also be transferred in the same process, to create images that glow when illuminated by ultraviolet (UV) light. Until now, this has been carried out only with single colour fluorescing dyes, usually blue. These products have found applications in some DVLC contracts in the US.

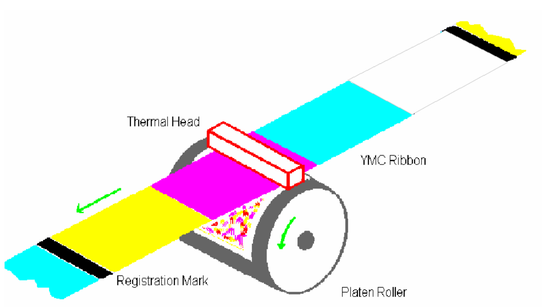

Figure 1. D2T2 with a YMC ribbon

We were keen to develop this concept by exploring the potential for printing with dyes fluorescing red, blue and green such that under UV light they would combine additively to give full-colour images. This effectively corresponds to the process by which a display on a CRT combines light from red, green and blue (RGB) phosphors, to give additive color reproduction. The final effect we were looking to achieve, was an image, invisible under normal daylight conditions, but which would be fully visible and recognisable as a full-colour continuous tone image when illuminated by UV light

Discussion

In order to print full-color D2T2 fluorescent images, the ribbon requires panels of blue, green and red fluorescent dyes. These dyes have to be selected for their ability to transfer by dye diffusion as well as to meet the normal criteria for stability etc. They can be arranged in any order, but it is convenient to put them in the order BGR, thus reflecting the normal CMY arrangement of a ribbon. Figure 2 illustrates the ribbon.

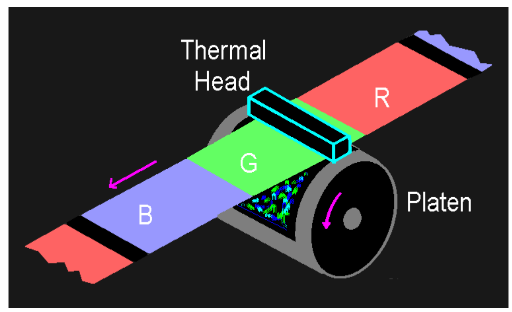

Figure 2. D2T2 with an RGB ribbon

A feature of the additive system is that the requirements for printing directly corresponds to the RGB components of a digital image, whereas normal CMY printing requires an inversion. An easy way to use a printer that has already been set up for normal CMY printing is to use a photo-editing package to invert the image into a negative. The printing process then inverts it again, so that overall a positive image is printed.

For optimum colour rendition it is desirable to use RGB dyes that have emission spectra close to those chosen for CRT displays, ideally having emission maxima at about 610 nm, 550 nm and 470 nm. In practice, the eye is relatively forgiving of a luminous image against a dark background, and it is also possible to apply color correction to optimize the image. A further limitation is the stability of UV dyes available, which does put constraints on the colour reproduction achievable.

Figure 3. Two cards photographed under normal illumination

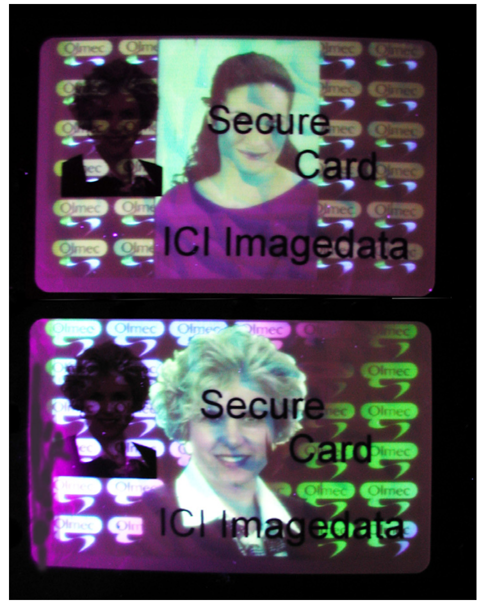

Figure 4. The same cards as those in Figure 3 under UV illumination

Applications

There is an increasing need for security features in documents such as identity cards. A full-colour fluorescent image provides a covert feature, which is not apparent on casual inspection, but is readily shown up under UV illumination. The fluorescent image can either be in an otherwise plain area of the card, or can be overprinted with other information. In general, the overprint needs to be fairly pale in color in order not to mask the fluorescent image.

Figure 3 shows two apparently identical cards under normal illumination, and Figure 4 shows the same cards under UV. Clearly, the images match in the case of the second card but not the first.

Conclusion

Full colour continuous tone fluorescent images with high visual impact can be generated by printing a sequence of blue, green and red fluorescing dyes, in place of standard CMY dyes, by thermal dye transfer (D2T2). These images can be generated using standard D2T2 printing equipment.

Author Biographies

Ian Stephenson graduated in chemistry from Durham University in 1984, following this with a PhD also from Durham in 1987. He joined ICI in 1987, moving to ICI Imagedata in 1991 where he has held roles within R&D and Manufacturing within Imagedata's imaging media businesses, before taking on his current role of R&D Director in 2000.

Richard Hann graduated in chemistry from the University of Oxford, England in 1967. After a Ph.D. at Sussex, England and postdoctoral work at UBC (Canada) and Exeter (England) he joined ICI. He worked on imaging media since 1984 as part of ICI Imagedata, and until his recent retirement was their Principal Scientist. He is author of more than 50 papers and 37 US patents, and is a member of the IS&T.Richard Hann graduated in chemistry from the University of Oxford, England in 1967. After a Ph.D. at Sussex, England and postdoctoral work at UBC (Canada) and Exeter (England) he joined ICI. He worked on imaging media since 1984 as part of ICI Imagedata, and until his recent retirement was their Principal Scientist. He is author of more than 50 papers and 37 US patents, and is a member of the IS&T.