Multi Color Thermal Imaging by One-pass Printing with a Single Printhead

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Abstract

Multi-color thermal images can be obtained by single pass printing and single thermal printhead technique. The systems described in this paper are combinations and modifications of well-established thermal imaging processes. These systems can be used for printing multi-color documents containing text and graphics. Although complete separation of all colors cannot be achieved by this process, successful rendition of a digital image can be obtained by proper selection of the individual components of the system and printing conditions. These systems can also be extended for printing security features by thermal imaging.

Introduction

Direct thermal printing systems, using a single sheet and a single printhead for generating monochrome images are well known in imaging industry. Thermally transferred images from a donor ribbon to a suitable receiver are also obtained by various systems. Due to the difference in energy requirements of the two systems it is possible to combine the two systems and obtain multi-color images by single pass printing, using a single thermal printhead. The details and advantages of such a system are described in this paper. Although complete separation of all the colors is not achievable by this method, it would be useful for inexpensive and high speed printing where absolute reproduction of color is not essential.

Description of the System

The system for obtaining a two-color image consists of a receiving layer of image forming materials, containing leuco dye and developer, coated on a substrate and a donor ribbon, containing a different color dye-containing non-crystalline phase. For durability and improving the image quality of the transferred dye, a receiving layer suitable for the dye is coated over the layer containing the leuco dye and developer. Table I describes a general version of the system.

During thermal printing at lower energy levels the dye from the donor is transferred imagewise to the sheet. At higher energy levels the image is formed due to the reaction of leuco dye with developer present in the sheet, as well as the transferred dye from the donor, and the resulting color is the combination of the two colors. At the intermediate energy levels the colors would be the combinations of varying amounts of the two dyes from sheet and donor. By varying the printing energy levels significant variations can be obtained in the midtones and shadow regions. Figure 1 shows a typical density vs. energy curve obtained for such a system.

Table I: Components of a System

Receiver sheet	
Base	Polyester (4 mils)
Image layer	Color former indicator dye
	Acid developers
Receiver layer	Binder
	Silica
Donor ribbon	
Base	Polyethylene-terephthalate (4.5 microns)
Image layer	Dye glass
	Crystalline thermal solvent
Thermal imaging process	
Thermal printhead	Standard type for monochrome prints
Maximum energy	2.5 – 3.2 J/cm^2
Printing temperature	22 – 25^{o}C

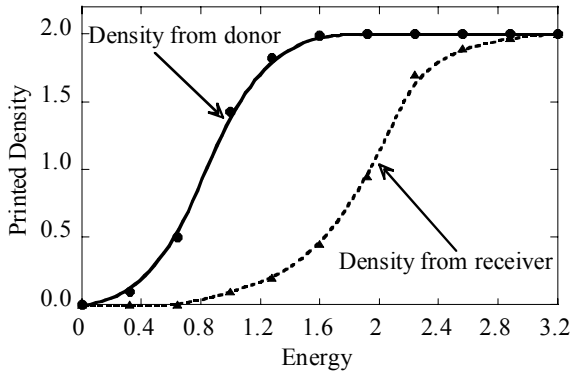

Figure 1. Printed Density vs. Energy

An extension of this system would consist of a receiving layer containing more than one leuco dye-developer systems, requiring different energy levels for imaging, but significantly higher energy than what is required for transferring the dyes from donor. The final image obtained would have various color combinations of the two colors from the receiving sheet and the one from the donor. Another application of this system would be for security printing in which the donor consists of a uv-absorber instead of a dye. Under ambient light only the image from to the turned on leuco dye would be visible, but the image from the transferred uv absorber would only be visible when viewed under uv light (also sold commercially as 'black light').

Advantages

The advantage of such a hybrid system is the speed of printing because of one pass printing, and lower cost due to the requirement of a single printhead.

Summary

A combination of two well established thermal imaging systems can be used for generating high speed low cost images where perfect separation and reproduction of color is not essential. These systems can have several applications, including labels and security printing.

Author Biography

Fariza Hasan, currently employed at Polaroid Corporation in Massachusetts, received her Ph.D. in chemistry from University of British Columbia, Vancouver, Canada. Her graduate and post-doctoral research included kinetics and mechanisms of various inorganic, organic and biochemical reactions. In her current position, she has been involved in optimization and design of several existing and new silver halide and digital imaging systems. She has a total of approximately 40 scientific publications and patents, and is a member of the IS&T and the American Chemical Society.