Direct Plate-making for Lithography by Laser Heating

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Abstract

The development of the Computer-to-Plate technology is necessary for the full digitization in the lithographic printing process. The new direct-plate making by laser heating is investigated. The multi-layered laser plate is composed of the silicone top layer, the laser light absorbing layer and the porous layer containing Zinc-Oxide powder and binder polymer. The both of silicone and laser light absorbing layers exposed to the laser light are melted and penetrated in to the porous layer. The image and background areas exhibit ink acceptance and repulsive, respectively. This plate is used for the lithographic printing plate.

Introduction

In the graphic arts, the technologies of Computer-to-Plate, CTP are developed in response to the demand of the full digitization of conventional printing process. The CTP is a method for making printing master plate directly using digital data. The high power laser diode was used for the heat source in laser thermal imaging. We have reported the direct plate making process using the laser thermal wax transfer[1,2] and the penetration of polymer into the porous layer.[3-5] In this paper, we propose the new direct-plate making process by laser heating. The mechanism, imaging and printing characteristic of laser direct printing plate are discussed.

Experimental

Sample and Laser Recording System

Figure 1 shows the sectional view of sample. The mixture of ZnO powder (Sakai Chemical., Sazex 2000) and PMMA Polymer (Wako Chemical.) was coated on base film by using wire bar coating. The mixture ratio of ZnO to binder polymer is 10 to 1, and the layer thickness is 15 micrometer. The mixture of infrared light absorption dye (Mitsui Chemical., PA1006) and PMMA was coated on the ZnO polymer layer. The layer thickness is 1.5 micrometer. Finally, the mixture of silicone emulsion and PVA polymer was coated on the two layers as top layer. The layer thickness was 0.7 micrometer.

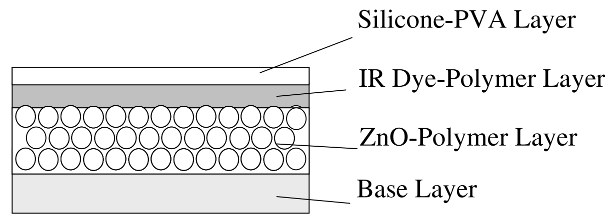

Figure 1. Sample for direct imaging.

A schematic diagram of the laser thermal dye transfer printing system is shown in Figure 2. There are three main sections: an optical head which includes the laser diode with power of 100mW and wavelength of 825 nm, a printing drum which performs the main scanning, and a sub-scanning section which moves the optical head using a micro-stage. The laser diode is operated according to the image signals, and the drum rotation and micro-stage movement are controlled by a microcomputer. The sample was set on the drum, and dots and solid images were recorded under the recording condition which a laser power is 40 mW and recording speed is 67 mm/s.

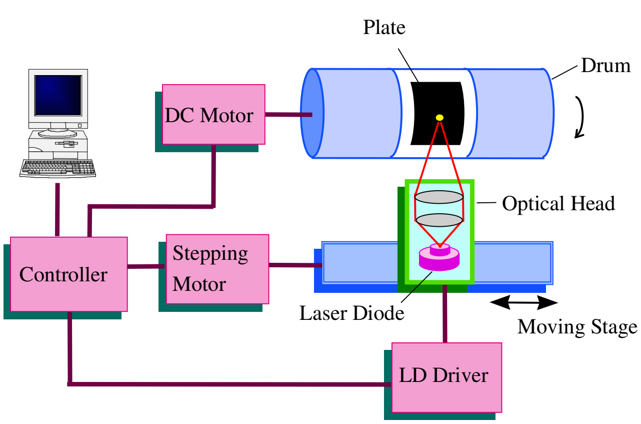

Figure 2. Schematic diagram of the laser recording system

Principle of Direct Laser Thermal Imaging

A principle of laser thermal imaging to make the printing master plate for dry offset printing is shown in Figure 3. The both of silicone top layer and laser light absorbing layers are melted when the laser light absorbing layer is exposed to the laser light as shown as in Fig.3 (a) and (b). The both of silicone top layer and laser light absorbing layer are penetrated in to the porous ZnO-polymer as shown in Fig.3 (c). The area exposed to laser light exhibits acceptability of ink because the surface of ZnO-polymer layer appears. The ink is not accepted at the non-exposed area to laser light. This plate is used for the dry lithographic printing plate.

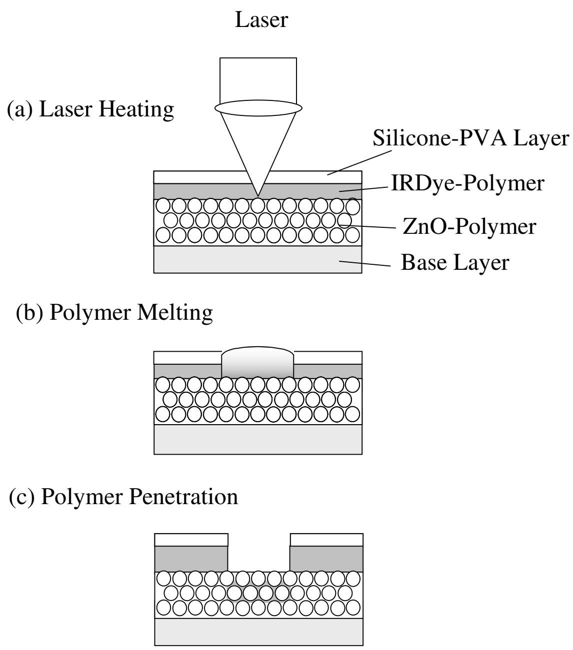

Figure 3. Imaging process to make dry offset printing plate.

Mixture Ratio of Silicone Emulsion to PVA

Figure 4 show the scanning microphotographs of the dot and solid images as the function of mixture ratio silicone emulsion to PVA polymer. Photographs show the surface of three samples containing of 60, 70 and 85 wt% silicone polymer in the top layer. The surface of ZnO-polymer layer appears at dots area exposed to laser light and all of top layer does not exist on the solid area of ZnO-polymer layer exposed to laser light as is shown in Fig. 4(a). Silicone polymer has remained and the dome of silicone polymer formed at dot exposed to laser light for the sample having silicone mixture percentage of 70 and 85wt%. The top layer contained with 60wt% of silicone polymer is penetrated into ZnO-polymer layer by laser heating.

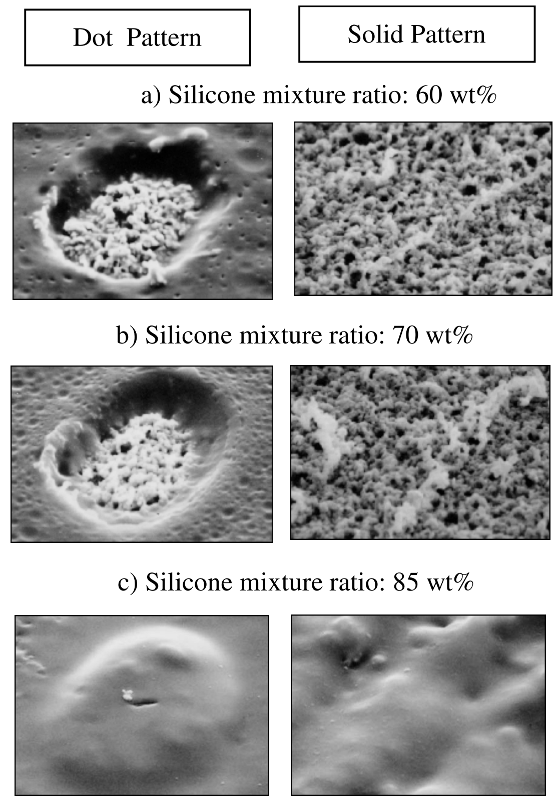

Figure 4. SEM photographs of dot and solid images.

Contact Angle

Figure 5 show the relation between the contact angle and mixture ratio of silicone emulsion to PVA polymer. The contact angle was calculated using the angle between the surface of sample and liquid droplet of ion-exchanged water and methylene iodide. The sample containing of 60 wt% of silicone exhibits oleophobic surface property.

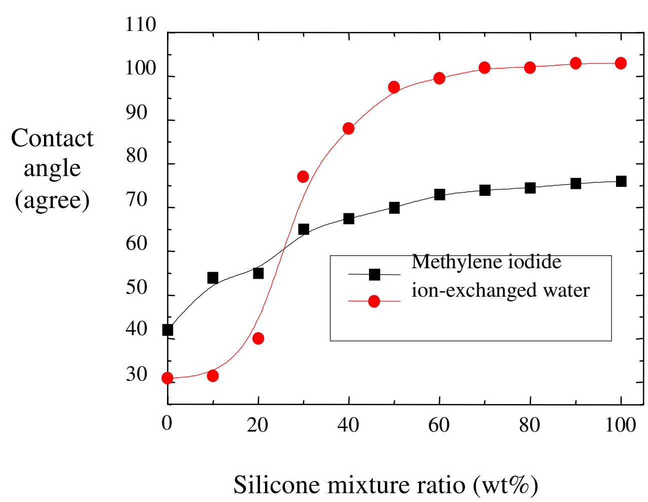

Figure 5. Relation between the contact angle and mixture ratio of silicone to PVA polymer.

Mixture Ratio of ZnO to Binder Polymer

Figure 6 show the scanning microphotographs of the dots and solid images as the function of mixture ratio ZnO and PMMA polymer. The top layer was penetrated into ZnO-binder layer which the mixture ratio of ZnO to binder polymer is 6 to 1. It is necessary for polymer penetration to make a lot of air gap in the ZnO-polymer layer,

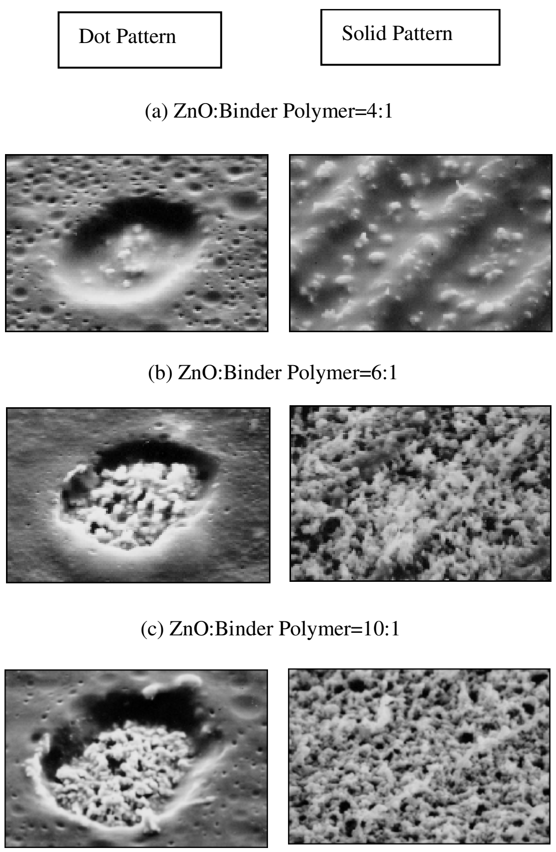

Figure 6. Scanning microphotographs of the dots and solid images as the function of mixture ratio ZnO and PMMA polymer.

Conclusion

The multi-layered laser plate is composed of the silicone top layer, the laser light absorbing layer and the porous layer containing Zinc-Oxide powder and binder polymer. The both of silicone and laser light absorbing layers exposed to the laser light are melted and penetrated in to the porous layer. The image and background areas exhibit ink acceptance and repulsive, respectively. This plate is used for the dry lithographic printing plate.

References

1. R. Saito, T. Kitamura and H. Kokado, The proceedings of the 96th spring conference of Japanese Society of Printing Science and Technology, pp. 63-66 (1996).
2. J. Nishimura and T. Kitamura, The proceedings of the 100th spring conference of Japanese Society of Printing Science and Technology, pp. 85-88 (1998).
3. J. Nishimura and T. Kitamura, The proceedings of the 102th spring conference of Japanese Society of Printing Science and Technology, pp. 17-22 (1999).
4. J. Nishimura, K. Hoshino and T. Kitamura, The proceedings of Japan Hardcopy '99, pp. 375-378 (1999).
5. S. Morito, K. Hoshino and T. Kitamura, The proceedings of the 106th spring conference of Japanese Society of Printing Science and Technology, pp. 1-4 (2001).

Biography

Takashi Kitamura received the B.S. and M.S. degrees in graphic engineering from Chiba University in 1970 and 1972, respectively, and the Dr. Eng. Degree from Tokyo Institute of Technology in 1983. He was a Research Associate at Chiba University from 1972 to 1985, doing work on Electrophotography. He was a Associate Professor from 1985 to 1997 and has been Professor in Information and Image Sciences Department, Chiba University since 1997.

He has served as Program Co-chair and Steering Chair on 7th and 9th Non-Impact Printing Congress on 1991 and 1993, respectively. He was NIP Technical Council Member of IS&T from 1992 to 1997. He was the IS&T Tokyo Chapter Secretary from 1996. He received Senior Member Ship and Follow on 1994 and 2000, respectively.

His research interests are in Physics of Organic Photoconductor, Laser Thermal Transfer and Electronic Paper Imaging.