TAGA History of Lithographic Plates

Richard M. Goodman

Keywords: Lithographic printing plates, TAGA history, CTP

Introduction

This article will briefly review the structure of the lithographic plate as it is manufactured today and how it evolved over the last 60 years. Inventions, especially those which significantly improved lithographic plates, are highlighted. The special emphasis is on how these developments were described in TAGA Proceedings over the sixty year period. Since this TAGA Annual Technical Conference (ATC) is the 60th in its history it is most appropriate to highlight how TAGA ATC's have provided the glimpse of the future in offset lithography throughout its 60 technical conferences. We will not cover the hundreds of articles which dealt with other aspects of offset lithography, e.g. inks, paper, presses, etc.

Generically the term image carrier refers to the "printing form" or transfer medium, holding the image defined by the input data (now usually digital, formerly film-based), which accepts the ink and applies it to the output substrate. Image carriers include gravure cylinders, flexographic plates, screens and lithographic plates. Strictly speaking since virtually all lithography is printed offset (that is, the plate transfers the ink to a blanket which then transfers the ink to the substrate) lithographic plates are unique image carriers in not directly contacting the substrate during the printing operation. Also, uniquely most practical lithographic plates are virtually planographic, that is, the image is neither raised above nor recessed below the background or non-image areas, but is (typically within 2 microns) in the same plane.

Offset lithography is currently the dominant industrial printing process with a market share of about 40% of all printed pieces, including direct digital processes. Lithography is used in virtually all applications, from newspapers to commercial to books to packaging and everything in between. We will conclude with a brief glimpse of the future for developments of new lithographic printing plate concepts.

Richard M Goodman Consulting LLC, Briarcliff Manor, New York

Brief Early History of Lithographic Plates

The history of Lithography traces back to Sennefelder in 18th century Germany: he created an image carrier by rubbing wax onto lime stones-actually not too different from current artists' lithographs. The first modern offset lithographic printing plates were produced in the 20th century – they consisted of a uniform thin metal sheet upon whose smoothed surface a photosensitive coating (usually of diazo-type chemistry) was applied by the printer just prior to its use on press.

First modern offset lithographic plates were produced in mid 20th century. The making a lithographic printing plate could be characterized in the following process:

- Diazo coating applied by the printer just before running on press
- Often took hours to process
- Often ran less than 50,000 impressions
- Quality worse than letterpress

This remained the state-of-the-art into the mid-century when the Technical Association of the Lithographic Industry (TALI) was formed in 1947. At its first meeting in 1948 it featured several papers on lithographic plates, including one by G.N. Martin of the LTF (Predecessor to the PIA/GATF) on "Wettability and the lithographic properties of metals."

Brief Early History of the Lithographic Plate from TAGA Proceedings: The Rise of Aluminum as the Dominant Substrate

In 1949 the organization changed its name to TAGA, its current name, and shortly thereafter (in 1953) Brinnick described, "Pre-sensitized Plates," the first major advance in the concept of the lithographic plate. Nevertheless, pre-sensitized plates did not become standard for another 20 years. One crucial aspect was the development of aluminum as the dominant substrate. Two key historic landmark papers are the 1970 paper by Powers, "Anodizing for the graphic arts industry," and the 1972 paper by Zelley, "Surface characterization of ball grained and brush grained Al lithographic plates." These described the manufacturing advancements in the art, respectively, the hardening of the Al surface by anodizing and its "roughening" by mechanical graining. As first developed in the 1970s and still practiced today, graining transforms a smooth plate into a high surface area product. In 1981 a Fuji patent (Sakaki, et.al.) describes a good grain as characterized by

> "An aluminum alloy plate the surface of which has been grained such that the grain structure comprises pits and (i) the distribution of pit diameter is such that the pits corresponding to 5% and 95 % on a cumulative frequency curve for pit diameter are about 3 microns or more and about 10 +/- 1 microns in diameter, respectively and (ii) the center line average roughness (Ra) of said surface is on the range from about 0.6 to 1.0 microns." It is depicted in figure 1.

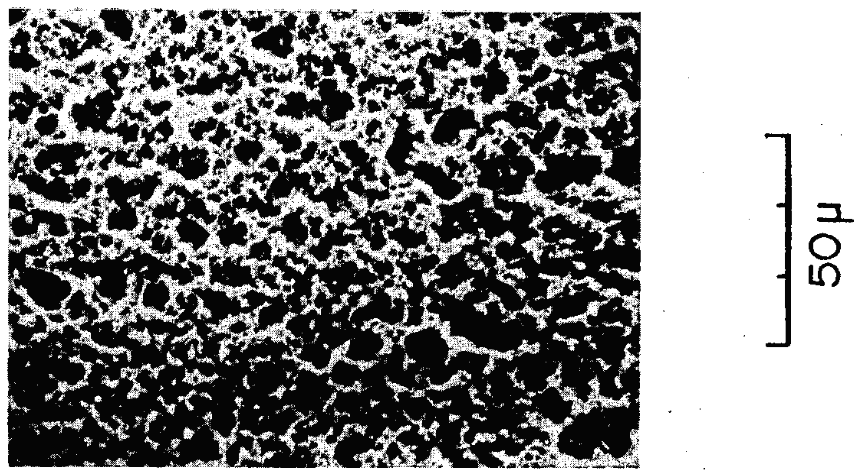
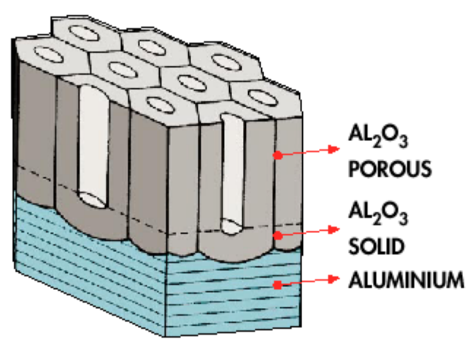


Figure 1. SEM image of the ideal grain structure

This type of graining promotes adhesion by the pre-sensitized coatings and better water holding during runs on press.

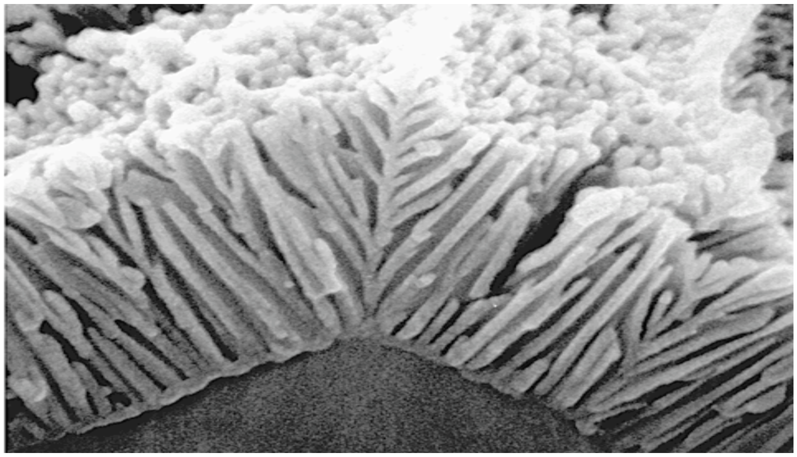
Anodizing provides the totally unique advantage to aluminum substrates. That is, aluminum is relatively lightweight, easily purified and fabricated into uniform sheets. But its surface is relatively soft and easily burnished or scratched. However, by anodizing the surface is transferred into a very tough, hard aluminum oxide structure as depicted in figures 2,3 below.



MODEL OF THE OXIDE LAYER FORMED BY ANODIC OXIDATION OF ALUMINIUM

Figure 2. Diagram of the anodized aluminum structure

The figure 3   SEM picture of an actual anodized aluminum surface with columns of about 1000 nanometer widths.



These figures clearly show the aluminum oxide structure built up from the aluminum surface much like the modern honeycomb composites giving great strength against compressive forces and, since the oxide is very hard, good protection from scratches as well. Nevertheless, at the 1972 ATC Dean and Ford described, “Mechanisms of plate wear and failure in anodized aluminum lithographic plates,” highlighting shortcomings in the recently developed anodizing processes.

In 1986 Chou and Leidheiser described another advance in the art of substrate treatments, “Effects of the sealing process on wettability and wear properties of anodized Al lithographic Plates.” That is, by suitable chemical treatment of the grained and anodized surfaces the aluminum oxide becomes both uniquely receptive to adhesion by polymeric organic photo-coatings (see below) and receptive to wetting by the fountain solutions where the substrate is exposed during exposures and development.

Brief Early History of the Lithographic Plate from TAGA Proceedings: Improved Photo-coatings and Computer to Plate (CTP)

Departing from the advancements in the substrate developments we look into novel ideas for the coatings. In 1974 Anastasio and Ferrero described “Projection Platemaking.” This breakthrough technology, not widely commercial till the mid-1980s, enabled exposure at very much higher speeds than previously. Interestingly, Theran in 1983 wrote of “Projection Plate making-An Interface to the future.” (As adopted then by The Wall Street Journal it was really the first computer to plate concept commercialized). In a striking premonition of the future Amtower in 1982 wrote about “The Accelerating pace of computer-to-plate” some 13 years before the first demos at DRUPA of a practical CTP plate as we know it today. A significant advance was previewed in 1987 by Potts, “Offset negative plates-the moves to aqueous processing chemistry.” Prior to this development all coatings required development by strong solvents (e.g. cyclohexanone) causing hazardous conditions for the plate workers and difficulty in disposal for the print shops. The new coatings could be developed in aqueous friendly developers with only a few percent of (usually less onerous) solvents. This ecological advance was not mainstreamed for another 5-7 years because of the need to prove these new plate coatings were as tough as the older solvent developed ones.

The first big attempt at CTP was presaged by Bardocz in 1992 with "GTO-DI direct to press spark discharge technology." Two years later Walls described, "Unconventional printing plate exposed by IR (830 nm) diodes." The operation is depicted in figure below. The principle was based on the incorporation of a component which decomposes at high temperatures to form a photo-initiator for the major polymeric material in the coating. Upon heating by the IR laser the initiator causes formation of a pre-polymer very rapidly. Upon further "baking" at a moderate temperature (~ 135 degrees C) the pre-polymer hardens into a very strong cross-linked ink receptive coating. The result is tough, durable printing plate which can be rapidly exposed by an IR diode laser driven digitally. That is a durable computer-to plate product. The process of producing the press ready plate is depicted in the figure below.

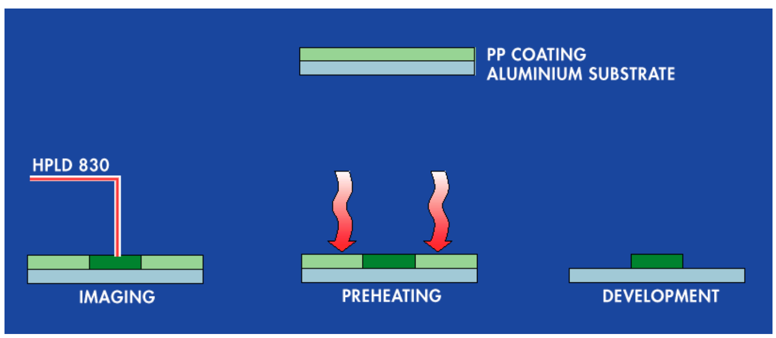


Figure 4. Depiction of the process to produce press ready "Walls" CTP plate.

This first practical commercial thermal CTP technology was not fully commercialized for another 5 years. Interestingly, in 1997 TAGA featured a special symposium titled, "Is CTP ready for prime time." But one year later, in 1998 van hussel, et. al., announced a new thermal CTP concept, "Thermostar: a new thermal litho plate technology for IR imaging." The CTP field soon became so crowded that Goodman and Nussel in 1999 published a full review of CTP technologies entitled, "The technology generations of digital thermal printing plates." These generations were respectively characterized as the first generation "pre-heat thermal and visible light plates" the second generation "no pre-heat" plates and the third generation plates called variously "no process" or "chemistry-free" plates because they don't use strong chemical developers to produce the printing images after exposures. TAGA is not only forecasting but providing perspective along the way as technologies enter the mainstream.

CTP involves tighter manufacturing controls than the older analog plates. Even the physical handling of the plates themselves requires a different approach than with analog plates. Because many digital plate imagers use the edge of the plate as a reference point for calculating image placement, digital plates have very strict requirements in terms of edge straightness and uniformity. With a conventional plate this is a relatively minor issue, but if a digital plate has uneven, non-straight or damaged edges, it simply won't work.

Despite these issues, the pace accelerated as even more CTP technologies were previewed at TAGA. Key papers included Schaschek"s "Waterless offset printing in future newspaper applications," in 2000 foreshadowing the development of the now successful Cortina newspaper press concept; Langlais"s 2001 description, " A novel litho surface for laser thermal ablation CTP," on the Anthem plate concept, depicted below.

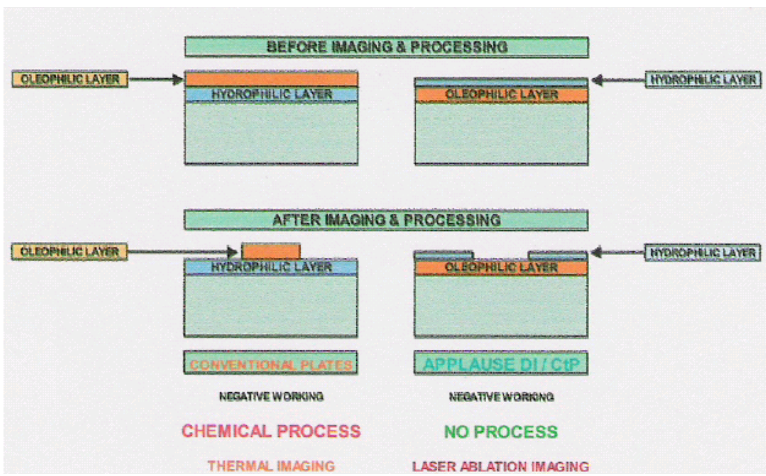
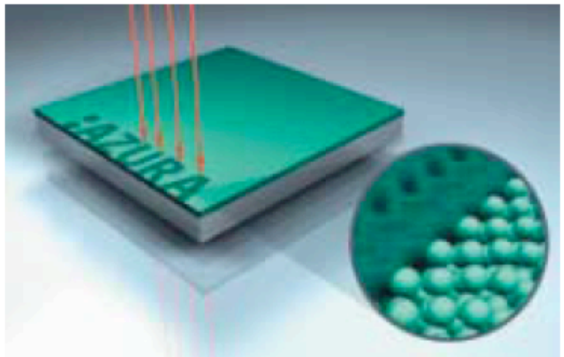


Figure 5. The process for imaging the "no process" Anthem plate

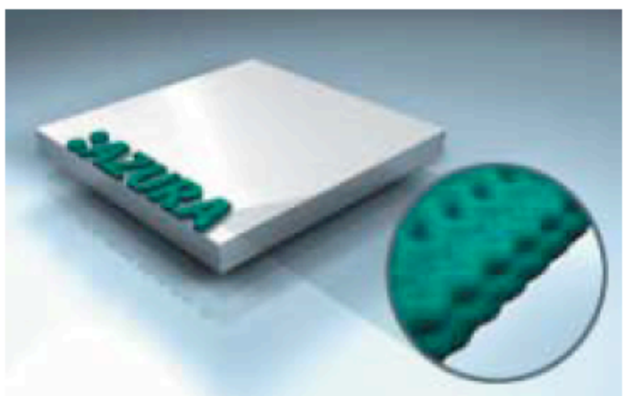
Vander Aa, et al., in 2005 presented "Thermofuse digital plate technology" describing the now successful Azura plate concept depicted in the two figures below.



Exposed :Azura plate
The coating absorbs energy from the 830 nm laser imaging head. The thermofusable pearls fuse firmly to each other and bond strongly with the standard grained and anodised aluminium base.

Figure 6. The exposure process for the Azura plate showing the unique thermally fusible "polymeric pearls" structure.

and anodised aluminium base.



Gummed :Azura plate
Application of the gum washes away the unexposed plate areas and creates a protective gum layer. The :Azura plate is now ready for printing.

Figure 7. The final washing and gumming process for the Azura plate showing the actual fused printing area

McCullough, et al, .in 2006 presented "A new photopolymer technology for develop-on press thermal CTP plates," describing the now successful Thermal Direct plate. Kull, et.al, presented, "Red hot and violet

Photopolymer systems at your service" to capture the explosion in violet plate CTP.

The Future of lithographic plate developments in Brief

With the development of both the no process CTP and on-press developable plates the advances in the CTP world (with improved violet as well as thermal versions to come) are reaching a plateau. With the spectacular growth of direct digital press concepts (not discussed herein but certainly featured in recent TAGA conferences) the market share held by the lithographic process is forecast to diminish and hence to diminish the inventive incentives.

A Recap from the 60 TAGA ATC conferences

The current lithographic plate is characterized by the use of special lithographic grades of aluminum sheet (of very definite, nearly pure, aluminum alloys specially formulated for strength and flatness), which are grained (carefully roughened to a definite extent), anodized (to produce a hard, essentially hydrophilic aluminum oxide), treated by an interfacial chemical to improve adhesion of organic layers, then over-coated by a highly sensitive, but physically tough, organic, photosensitive polymer coating. Key papers from the TAGA Proceedings have described the developments from the early pre-sensitized litho plates to the modern CTP litho plates. TAGA has captured the 60 year curve of lithographic plate developments from a process which entailed hours of chancy and laborious work by the printer to produce an image carrier of dubious quality and short press life to the current processless or on-press products capable of going from imaging data to printed copies often in ten minutes or less and meeting the absolutely finest printing quality and longest press runs often to 500, 000 impressions or more.

References

Amtower, Richard E.
1982 "The Accelerating Pace of Computer-to-Plate," TAGA Proceedings, pp 163–180.

Anastasio, Thomas A. and Ferrero, Joseph F.
1974. "Projection Platemaking," TAGA Proceedings, pp 1–22.

Bardocz, E. A.
1992 “GTO-DI Direct to Press Spark Discharge Technology,” TAGA Proceedings, pp 499–507.

Chou, Shem M. and Leidheiser Jr., Henry
1986. “Effect of the Sealing Process on Wettability and Wear Properties of Anodized Aluminum Lithographic Plates,” TAGA Proceedings, pp 247–266.

Dean Jr., S.W., Clark, D.G., Friberg, L.S., and Seese, R.G.
1972 “Some Examples of Defects in Aluminum Litho Plates and What Caused Them,” TAGA Proceedings, pp 235–248.

Goodman, R. M. and Nussel, B.
1999 “The Technology Generations of Digital Thermal Printing Plates,” TAGA Proceedings, pp 264–279.

Herting, H. Peter and Goodman, R.M.
1998 “Computer to Plate Technologies-The Current Product Realities” TAGA Proceedings, pp 312–328. .

Kull, S., Timpe, H-J., Flugel, M. and Baumann, H.
2005 “Red Hot and Violet. Photopolymer Systems at Your Service,” TAGA Proceedings, pp 153–168.

Langlais, E.
2001 “A Novel Lithographic Surface for Use with Thermal Ablative CTP,” TAGA Proceedings, pp 526–553.

McCullough, C. and Ray, K.
2006 “A New Photopolymer Technology for a Develop-On-Press Thermal CTP Plate,” TAGA Proceedings, pp 315–331.

Potts, Dr. Rodney M.
1987 “Offset Negative Plates—The Moves to Aqueous Processing Chemistry,” TAGA Proceedings, pp 352–370.

Powers, Lohn H.
1970 “Anodizing for the Graphic Arts Industry,” TAGA Proceedings, pp 166–185
.

Sakaki, H., Shirai, A., Ohashi, A.,
1981 “Electrolytically grained aluminum support for making a lithographic plateand presensitized lithographic printing plate, US patent 4, 301,229.

Schaschek , K.
2000 “Waterless Offset Printing in Future Newspaper Applications, “ TAGA Proceedings, pp 503–508.

Theran, Leonard
1983 “Projection Platemaking—An Interface to the Future,” TAGA Proceedings, pp 482–494.

Vander AA, J., Vermeersch, J. And Van hussel, J.
2005 “Thermofuse Digital Plate Technology,” TAGA Proceedings, pp 135–152.

Van hunsel, J., Van Damme, M., Vermeersch, J.,
1998 “Thermostar: A New Thermal Litho Printing Plate Technology for CTP Recording,” TAGA Proceedings, pp 395–409.

Walls, J.E.
1994 “Unconventional Printing Plate Exposed by IR (830 nm) Laser Diodes,” TAGA Proceedings, pp 259–267.

Zelley, W.G.
1972 “Surface Characteristics of Ball Grained and Brush Grained Aluminum Lithographic Plates,” TAGA Proceedings, pp 262–276.

.