Dr. E. Jennings Taylor • Faraday Technology, Inc.
315 Huls Drive • Clayton, OH 45315-8983 • E-mail: Jennings@erinet.com

An Increased Role for Intellectual Property In the Metal Finishing Industry

In the July column, I discussed the implications to the metal finishing industry of Prof. Charles Fine's concept of "clockspeed," the main premise being that all competitive advantage is temporary.[1] As companies continually compete for ownership of competitive advantage, industry supply chains continually oscillate between vertical/integral and horizontal/modular structure. The metal finishing industry is currently a classic horizontal/modular industry with powerful gatekeepers at the process chemistry point of the supply chain. However, the "fruit flies" of the metal finishing industry—electronics companies—are consolidating into large vertically integrated companies. As described by Prof. Fine, important drivers of vertical integration are:

> *"Technical advances in one subsystem can make that the scarce commodity in the chain, giving market power to its owner."*

The "market power" of a technical innovation resides in the "intellectual property" associated with the innovation. In order to consider the implications to the metal finishing industry, we must understand the term "intellectual property." The idea of property originated in ancient times and may have even preceded organized society, but quite simply implies control to the owner for using or selling the property, as well as excluding others from using the property.[2]

While intellectual property generally refers to patents, know-how (trade secrets or proprietary technology), and copyrights, I will focus on patents and the origins of the U.S. patent system. In the U.S. Constitution, the word "right" is used only once (don't confuse the Constitution with the Bill of Rights): the recognition of the natural rights of authors and inventors. Specifically,[3]

> *"To promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."*

Copyrights & Patents

Nearly 100 years after the Declaration of Independence, a young inventor and future president of the United States delivered a "Lecture on Discoveries and Inventions."[4,5] During this lecture, Abraham Lincoln identified six great steps toward liberty in history. According to Lincoln, one of the great steps was the law of copyrights and patents, which "…added the fuel of interest to the fire of genius leading to the discovery and production of new and useful things for the benefit of all mankind."

Lincoln, who was issued a patent in 1859, strongly believed that supporting and motivating human ingenuity by granting intellectual property rights was a significant achievement of the founders of the United States. It is curious that politicians today seldom speak of this aspect of liberty—the rights to our ideas—that was first recognized by the U. S. Constitution. There were, however, antecedents in English statutory and common law.

Early Applications

In fourteenth century England, a primary manner to promote the development of indigenous industries, *i.e.*, "economic development," was the use of "royal grants of letters patent" to those who agreed to introduce new industries based on those patents.[6] However, it must be noted that the issue of letters patent was solely at the discretion of the Crown as a grant of privilege, rather than a right of the individual to ownership of the idea. Consequently, under English tradition, letters patent were not considered property. The transition from patent custom to patent system was the recognition of the patent as a form of property—intellectual property—rather than a privilege bestowed by the government.[7]

The metal finishing industry has primarily utilized know-how in the form of proprietary process knowledge to secure competitive market advantage. As business has gotten more complicated, however, the need for more collaborative relationships between various points of the supply chain is required. Again, this is evident in the fast clockspeed electronic sector of the metal finishing industry, where strategic relationships involving the transfer and/or mutual use of intellectual property are common.

This new business case may have the strongest implications at the chemical process component of the supply chain, that is, the gatekeepers. For fabricating high-density interconnects containing microvias less than 150 μm, copper plating is becoming the limiting factor, that is, the force of change. Authors from a plating chemical supplier have recently reviewed the chemically mediated process for copper plating and discussed an electrically mediated process based on periodically pulsed reverse current.[8] Of course, as representatives of a chemical

supplier, they suggest that the chemical mediation should be combined with the electrical mediation.

But I see a different scenario, to paraphrase John Lennon's lyrics, "…Imagine that electrically mediated plating process control does not require difficult-to-control brighteners and levelers, …it's really not so hard if you try…some people say I'm a dreamer…"

In contrast to the "plating magician" with his "vats of 'magic' additives,"[9] this dream for the metal finishing industry is not based on magic. Rather, it is based on understanding how electric fields can fundamentally mediate the deposition process.

This understanding is key to fostering the collaboration between fabricators and process suppliers needed to deliver the technical innovations required by market demands. I have heard many complaints from metal finishers about how many of the consultants to the metal finishing industry, particularly consultants in the area of pulse current processes, promise to solve a particular process problem. However, they cannot tell you how they will solve the problem because you will then know their secret, *i.e.*, their know-how. In many cases, it is apparent that the secret is smoke and mirrors, then technology gets a bad reputation. If the consultants can solve the problem, they should be able to explain their approach. The question remains as to how the competitive advantage associated with the "show-how" is protected.

I suggest that patents can protect the electrically mediated approach. Since a patent is required to teach, the necessary trust between the fabricator and process supply component of the supply chain is fulfilled. Of course, it is difficult and maybe even impossible to make sure that a process patent is not being infringed upon or illegally used. But, both the compensatory and punitive damages associated with willful infringement are very high and deter infringement in other industries. Furthermore, even the current gatekeepers to the metal finishing industry—chemically mediated process suppliers—do not actually compete on their proprietary chemistry; rather, they compete on their ability to respond to process problems and client service.

What about patents, particularly in the area of electrically mediated process control? The first pulse current patent (actually pulse reverse current) that I'm aware of was issued in 1899. Subsequently, a number of patents dealing with pulse and pulse-reverse processes were issued in the early 1900s and continue today. So, is there anything left to invent in this field? There most certainly is, particularly in applying specific electrically mediated process parameters for specific applications. For example, a specific range of cathodic on-times, cathodic peak currents, anodic on-times, anodic peak currents and frequencies for electroplating high-density interconnects in the range of 10 to 150 µm. This is analogous to the approach taken in patenting new alloys—specific composition ranges for specific alloy applications.

In summary, recent market demands are driving both new technological innovations based on electrically mediated process control and new business models based on collaboration. The major barrier to this "force of change" is the resistance by fabricator and process supplier components of the supply chain. The fabricators, in exchange for new electrically mediated process capability and "show-how," will have to be willing to remunerate the process suppliers for the intellectual property in terms of a license instead of tangible property consisting of metered chemical mediation. Although this at first seems quite radical, the supplier of either electrical mediation or chemical mediation is simply being paid for a fraction of the value created for the fabricator.

The chemically mediated process suppliers will have to be willing to "cannibalize" their current business practice based on proprietary secrets and know-how in order to meet the market requirements. Again, this thought is not so radical, in that the current process suppliers have the established market channels and, in fact, already compete on client service and support. As cited above, the supplier will continue to be paid for a fraction of the value created.

As evident from the fruit flies of the metal finishing industry, the forces of change are indeed upon us. The collaborative relationships between components of the metal finishing supply chain will include contractual agreements drafted around patents, as well as know-how. However, as cautioned by H.J. Knight, manager of DuPont's Intellectual Property Group:[10]

"While the patent provides the legal basis of the business relationship, the key to commercial success is the acquisition of know-how."

In other words, the transfer of property rights in the form of patents represents the new business paradigm; however, the patent itself is worthless without the transfer of know-how in the form of "show-how." New entrants to the supply chain will replace those who resist the new technological innovations and their associated new business paradigm.

In the next column, I discuss some of the early founders of electrochemistry and the historical origins of the chemically mediated process control approach. P&SF

References

[1] C. H. Fine, *Clock Speed: Winning Industry Control in the Age of Temporary Advantage*, Perseus Books, Reading, MA 1998.

[2] E.C. Walterscheid, "The Early Evolution of the United States Patent Law: Antecedents (Part 1)*" Journal of the Patent and Trademark Office Society*, September 1994.

[3] U.S. Constitution, Article 1, Section 8, Clause 8.

[4] Abraham Lincoln, "Lecture on Discoveries and Inventions," Jacksonville, Illinois, February 11, 1859, in *Speeches and Writings: 1859-1865* Library of America, Washington, DC, 1989.

[5] Michael Novak, *The Fire of Invention*, Rowman & Littlefield Publishers, Inc. New York, 1997.

[6] E.C. Walterscheid, "The Early Evolution of the United States Patent Law: II. The Early English Patent Custom (Part 2)" *Journal of the Patent and Trademark Office Society*, November 1994.

[7] E.C. Walterscheid, "To Promote the Progress of Useful Arts: American Patent Law and Administration, 1787-1836 (Part 1)" *Journal of the Patent and Trademark Office Society*, January 1997.

[8] G. Milad and D. Morrissey, "HDI Challenges," in *Proceedings of the IPC 3rd Annual National Conference on High-Density Interconnect Structures*, Mesa, Arizona, November 19-20, 1998.

[9] J. Dini, *Electrodeposition: The Materials Science of Coatings and Substrates*, Noyes Publications, Park Ridge, NJ 1993.

[10] H.J. Knight, *Patent Strategy for Researchers and Research Managers*, John Wiley & Sons, New York, NY 1996.