Highlights of the decade

⇦ — Visit www.pffc-online.com for the "AIMCAL Turns 30" Special Report
2000 — Establishes a Technical Advisory Panel
2001 — Merges Fall Technical Conference with the Bakish Intl. Vacuum Web Coating Conference
2001 — Publishes Third Edition of Metallizing Technical Reference
2003 — Merges with the Converting Equipment Mfrs. Assn. (CEMA)
2004 — Moves to larger quarters and expands full-time staff from two to four
2004 — Releases the first edition of the AIMCAL Defects Lexicon
2005 — Inaugurates WebHandlingBlog.com, WebCoatingBlog.com, SpecialtyWebCoatingBlog.com, and VacuumCoatingBlog.com
2006 — Adds ExtrusionCoatingBlog.com
2006 — Creates biennial AWEB (Applied Web Handling) Conference
2007 — Launches Converting School
2007 — Establishes www.AimcalJobs.com
2008 — Sets up www.ConvertingPortal.com
2008 — Publishes Fourth Edition of Metallizing Technical Reference
2009 — Initiates a series of webinars
2009 — Establishes Sustainability Award Competition
2011 — Name becomes Assn. of International Metallizers, Coaters and Laminators
⇨ — Visit www.aimcal.org for future highlights

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PFFC
PAPER, FILM & FOIL CONVERTER
A proud member of AIMCAL

AIMCAL turns 40!

Changes in the industry, business environment, and volunteer contributions have all played important roles in the success and growth of our association.

I have been fortunate to have participated in AIMCAL for much of its lifetime. As an active board member for the past ten years, I have had the privilege of meeting and working with a wide range of members and their companies. Without the AIMCAL forum, I may not have had these opportunities. Probably the largest benefit I have gained has been the personal interactions with key individuals from member companies, many of whom I may not have had the opportunity to meet or work with outside of AIMCAL.

The ability to access the fundamentals in technical, industry, and management expertise is unique to AIMCAL. Value to the members is apparent in the wide range of offerings, and despite a positive membership growth of more than 30% over this past decade, AIMCAL has strived to maintain a level of intimacy at its meetings and conferences that is conducive to networking and learning. In addition, the benefit of having different target audiences at the various meetings allows for a wide range of participation and interaction between members.

AIMCAL's ability to maintain growth and add value over the past ten years is a testament to its commitment to the member companies. A key factor for AIMCAL has been the growth and dedication of the AIMCAL staff. Looking back to my initial involvement, AIMCAL had a part-time staff. The addition of qualified and committed personnel has allowed volunteers to focus on new opportunities and value to the members.

Although over the past ten years, AIMCAL has lost several icons and key contributors to the industry, they laid the groundwork for the next generation of individuals to be able to grow and learn and become the next leaders in the industry. AIMCAL has provided me as well as many others with educational opportunities, mentoring via involvement, and access to an immediate network of experts to assist in growing this industry.

I am grateful for my involvement in AIMCAL throughout my career and look forward to what the next ten years will bring!

Statements

Mission

AIMCAL serves as the global forum for the flexible metallizing, coating, and laminating industry by providing resources, services, and information. AIMCAL collects and distributes information to increase industry knowledge, while fostering an environment that builds relationships and a spirit of cooperation between member companies worldwide.

Vision

The flexible metallizing, coating, and laminating industry will recognize AIMCAL as the premier global trade association providing superior value and services that foster wide profitable industry growth and health.

AIMCAL's ability to maintain growth and add value over the past ten years is a testament to its commitment to the member companies.

Liz Josephson

Elizabeth Josephson
2010 AIMCAL President
Sales Manager
Web Coating Products for Applied Materials

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A time to celebrate

After four decades of service, AIMCAL is stronger than ever.

By Deborah Donberg, Contributing Editor

When members of the Assn. of Industrial Metallizers, Coaters and Laminators approved a name change at this year's March Management Meeting, the result proved to be symbolic as well as practical. Effective Jan. 1, 2011, the word "Industrial" will change to "International," reflecting the global reach of both the association and the industry, yet keeping the acronym the same. The association changes with the times but remains AIMCAL, its mission to "serve the global forum for the flexible metallizing, coating, and laminating industry by providing resources, services, and information."

Craig Sheppard, executive director, explains, "When AIMCAL was first formed, it was really about the people who supplied the coated, laminated, and metallized substrates to the flexible packaging converters. That was what the term 'industrial' meant back then—the material suppliers. Since that time, many companies have become vertically integrated; many of our members not only produce those rolls but convert them as well. So the term 'industrial' has become somewhat confusing. And, of course, we are becoming more international, offering more value to areas outside of the US in terms of conferences, training, et cetera. So I proposed we change our name from AIMCAL to AIMCAL!"

The word "international" may be new to its name, but AIMCAL's global reach is not. For years the association has participated in exhibitions and brought training courses to Europe, India, and Japan. "Craig and the board have spearheaded increasing the international presence," says past president David Fletcher. "AIMCAL is certainly spreading its wings."

Past president Bill Yoder voted for the name change "because the word [international] is more correct now than ever before. AIMCAL's objectives have always been to provide value to our industry, and international coaters and laminators and their suppliers have been joining. We on the board all felt it was fitting to make the change."

In its April 2000 issue, *Paper, Film & Foil Converter* offered a supplement saluting AIMCAL on its first 30 years of service to its members and the industry. So this year, as the association celebrates its 40th anniversary, it seems appropriate to look at the accomplishments of the past decade. As we do, it will become clear that while the changes at AIMCAL have been many, the continuity of purpose remains steady.

Giant e-strides

Perhaps nowhere are the strides of AIMCAL in the new millennium more evident than at www.AIMCAL.org, where an amazing array of features offers both members and nonmembers resources in easy-to-use formats.

"AIMCAL was an early adopter of the Internet as a marketing tool. It came as a result of strategic planning and has been very well executed by AIMCAL's management team," notes past president Paolo Raugei. "In fact, I think it has become a key factor of their marketing strategy."

As blogging became a popular information medium, AIMCAL launched five sites to help members of the converting community locate the information they need to access new technology and issues facing their organizations and the industry. Each blog features an expert in that area.

- www.WebCoatingBlog.com—Dr. Ed Cohen
- www.VacuumCoatingBlog.com—Dr. Charles Bishop
- www.WebHandlingBlog.com—Dr. David Roisum
- www.SpecialtyWebCoatingBlog.com—Dr. John Fenn
- www.ExtrusionCoatingBlog.com—Dr. Eldridge Mount

An archive capability makes it possible to retain information and discussions for future reference.

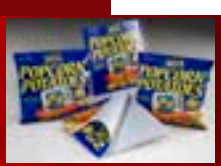
Launched in 2007, www.ConvertingSchool.com provides productivity-enhancing educational opportunities for members of the industry, expanding on the popular AIMCAL Summer School program the association has run for more than a decade. Course content combines theory with real-world problem solving and is tailored to the individual students present in each class.

"The focus of these classes is productivity enhancement," says Sheppard. "Students also will take home ideas for profit-boosting strategies related to process optimization and waste reduction, as well as higher, more consistent product quality and new product development."

The site www.ConvertingPortal.com provides a one-stop reference point for a wide range of information about converting technology, troubleshooting, training, and events. Primary links include Books and Publications, Technical Proceedings, Training/Tutorials, AIMCAL Jobs, Webinars, Industry Events, and the

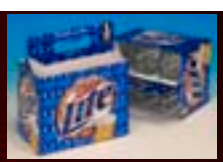
Product of the year winners

2010 | Graphic Packaging Intl.



2009 | Graphic Packaging Intl.

2008 | Grafo Regia



2007 | Graphic Packaging Intl.

2006 | Graphic Packaging Intl.

AIMCAL Defects Library. Links take website visitors to industry publications and trade shows as well as other organizations.

Are you looking for coated or metallized films or papers, adhesives, converting equipment, or services? The website www.AskAIMCAL.org allows users to submit requests to more than 220 companies worldwide.

One of the most recent (and popular) additions to the AIMCAL offerings is the webinar, cosponsored by *PFFC* and featuring an array of topics covered by top industry consultants. The recorded webinar is available on the website, free to anyone, for one week. After that it goes into the Audio Library for members only.

A recent webinar series covered Process Troubleshooting–Web Technology and Six Sigma Methodology; Vacuum Deposit Barrier Coatings; and Troubleshooting–Process/Adhesion/Vacuum. A 2009 Sustainability Series offered five sessions on what is probably the hottest topic in the industry. Sheppard says webinar signups come from all over the globe, and the association is building a resource for the future with the archived information.

Continuing to grow

In 2003 AIMCAL took a major step toward broadening its focus and serving its members by joining forces with the Converting Equipment Mfrs. Assn. (CEMA). Sheppard reported, "Bringing equipment suppliers and converters together will help both sides develop and implement new technology, improve efficiencies, build business, and establish new relationships."

Past president Frank Sereno said at the time, "The integration of CEMA as a division within AIMCAL adds value for members of both groups. [It] brings CEMA members closer to their customers and gives AIMCAL members access to highly respected educational offerings, especially in the area of safety, which has been a major focus of CEMA for many years."

While busy adding to its membership and offerings, AIMCAL continues its long history of informative conferences. In 2001 the Fall Technical Conference merged with the Intl. Vacuum Web Coating Conference, known as the Bakish Conference in honor of its founder Dr. Bob Bakish. Dr. Bakish still is actively involved with the conference and received the prestigious AIMCAL President's Award at the last fall conference.

The association also continues to promote networking opportunities, distribute economic information, and honor the best of the best at its annual awards competition. That competition now recognizes the "green" movement with a Sustainability Award. Added in 2009, the new award honors equipment, materials, or processes that reduce environmental impact, minimize energy usage or waste, and/or increase recycling.

Fit for the future

AIMCAL will face challenges in the years ahead, as will the industry. Fletcher says improvements in coating technology have led to less art and more science. "On the market side, there have been some very big changes. For example, in the early 2000s there was still a lot of demand for photographic films and film for audio and video tapes. That demand has diminished greatly. Now there's a huge demand for products relating to displays and photovoltaic applications. In another major shift, Asia has become a major consumer of the products our industry makes."

Fletcher believes the industry will meet these new demands successfully, as will the association. "AIMCAL is on the right track," he says. "I see continued membership growth, particularly with wider global presence. And certainly more use of information technology."

Bob Burgess, another past president of AIMCAL, also sees challenges ahead for the association. "They must continue to become more international and to embrace new segments that are involved in growth aspects of converting web materials, primarily medical converted products, green technologies, and solar power activities." Burgess sees a bright future for AIMCAL. "They have the tools and capabilities to make those changes."

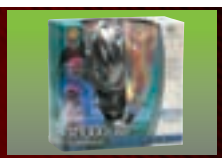
"There will always be more consolidation as certain segments become more mature," adds former president Chuck Larsen. "I see quite a few technical innovations. Flexible packaging is an ideal answer for some of the environmental concerns, and a great deal of innovation will come there. Also, the sputtering markets, LEDs, LCDs, and these product lines, there's tremendous innovation coming there. I see exciting times ahead but continuing competitive difficult times as well. That won't go away."

Having an association such as AIMCAL during those difficult times will ease the way, according to a couple of past presidents. "AIMCAL provides a gathering place…for face-to-face contact," says Yoder. "It's the best value I have ever found to improve the companies I have worked with."

Larsen agrees. "AIMCAL is an association with people who are very nice and easy to relate to, who come together to discuss common issues, and who help each other out. The association is extremely helpful, especially to new people in the industry. This is its history, this is part of AIMCAL's culture." Burgess agrees as well. When asked what is special about AIMCAL, he is quick to answer, "The people."

"Despite the association's many accomplishments, the best is yet to come," Sheppard predicts. "We expect the next ten years to bring even more new services and value to members around the globe."

For more on AIMCAL and the coating industry, check out our timeline of highlights from the past decade, see Charles Bishop's article on vacuum web coating (p42), Ed Cohen's take on converting technology trends (p47), and the winners of the Peter Rigney Product of the Year Award for the past ten years (below). Definitely pay a visit to www.AIMCAL.org, and keep your eye on the future. AIMCAL will be there.



2005 | Unifoil

2004 | Celplast Metallized Products

2003 | Unifoil

2002 | Proma Technologies

2001 | DuPont Teijin Films

Member directory

AIMCAL's new board of directors: (first row from left) Bob Connelly, CEO, Madico; Mike Engel, COO, FLEXcon; Liz Josephson, sales manager, Applied Materials; Dan Bemi, regional sales manager, Megtec; Mark Montsinger, R&D manager, Bryce Corp. (Second row from left) David Bryant, president, Vacuum Depositing Inc.; Craig Sheppard, executive director, AIMCAL; Gary Phillips, VP sales/marketing, Bekaert Specialty Films; Ron Schmidt, VP market development, Maxcess Intl.; Steve Sedlak, sales manager, ESK Ceramics. (Not pictured is Danis Roy, general manager, Terphane.)

3 Sigma Corp.
A&B Films Pte. Ltd.
ABBA Roller LLC
Achilles USA Inc.
Adhesive Applications
Adhesives Research Inc.
Advance Systems Inc.
AET Films
Air Liquide Industrial US LP
AJ Plast Public Co. Ltd.
American Roller Co.
AmTopp Div., Inteplast Group Ltd.
Angstrom Sciences Inc.
Anguil Environmental Systems Inc.
Apical Div., Kaneka Texas Corp.
Applied Materials
Arlon Inc.
Ashland Performance Materials
Aspect Automation
Atlanta Nisseki CLAF Inc.
Avery Dennison
BASF Corp.
Bekaert Specialty Films LLC
Berry Plastics Corp., Tapes & Coatings Div.
BIOFILM S.A.
Bobst Group NA, Flexible Materials
Bostik Inc.
BPR Plastics
Brady Worldwide Inc.
Brooks Automation Inc.
BrushFoil, div. of Interfilm Holdings. Inc.
Bryce Corp.
C2 Coating & Converting
C.A. Litzler Co. Inc.
Camvac Ltd.
Canslit Inc.
Catalina Graphic Films Inc.
Catbridge Machinery
CBC Coating Inc.
Celplast Metallized Products Ltd.
Chase Corp.
Circonix Technologies LLC
Clemson Univ., Dept. of Packaging Science
Cloeren Inc.
Commonwealth Laminating & Coating Inc.
Convert-all Inc.
Converting Today
Cork Industries Inc.
CoSo LLC
CPFilms Inc.
CPP EXPO
Crown Roll Leaf Inc.
Cytec Industries
Dark Field Technologies
Darly Custom Technology Inc.
Davis-Standard LLC
Deposition Technology Innovations
Dienes Corp.
Donaldson Co. Inc.
Dow
Dunmore Corp.
DuPont Teijin Films
Eastman Kodak
ESK Ceramics
Ester Industries Ltd.
Exopack Advanced Coatings
Extrusion Dies Industries LLC
ExxonMobil Chemical, Films Business
Faustel Inc.
Filmquest Group Inc.
FILMtech Inc.
Finzer Roller
First Quality Nonwovens
First Technology Innovation Inc.
Flexible Packaging Magazine
FLEXcon Co. Inc.
Franklin Adhesives & Polymers
Garware Polyester Ltd.
Gencoa
General Metallisers Ltd.
Glatfelter
Global Technologies LLC
Grafo Regia S.A. De C.V.
Graphic Packaging Intl. Inc.
Hanita Coatings RCA Ltd.
Harper Corp. of America
Hazen Paper Co.
H.C. Starck Inc.
Henkel Corp.
Hewlett Packard
Honeywell Specialty Films
Hueck Folien GmbH
Hutchison Miller Sales Co.
Illinois Instruments Inc.
Imperial Rubber Products Inc.
Impreglon Inc.
Inometa Inc.
INTEGRITY Roller Services
Intertape Polymer Group
InterWrap Inc.
IntrAL Inc.
ITASA
JBF RAK LLC
JDSU/Flex Products Group
Jen-Coat Inc.
Jennerjahn Machine Inc.
Jessup Mfg. Co.
Johnson Laminating & Coating, Inc.
Kennametal Sintec USA
Kimoto Tech Inc.
Kraft Foods
L.C.O.A.
Lamart Corp.
Leybold Optics GmbH
Loparex Inc.
Mack Brooks Exhibitions Inc.
MACtac
Madico Inc.
Malaga Produtos Metalizados Ltda.
MANFISA (Manufacturas Irular, S.A.)
Mario Cotta America
Maxcess Intl. Corp.
Measureitall.com
ME.RO S.r.l.
MEGTEC Systems
Mica Corp.
Michelman
MIRWEC Film Inc.
Mississippi Polymers Inc.
Mitsubishi Materials
Mitsubishi Polyester Film Inc.
Montalvo Corp.
MPI Technologies Inc.
MTI & Polyexe Corp.
NDC Infrared Engineering
New Era Converting Machinery Inc.
NewPage Specialty Papers
NESTEC Inc.
Nordmeccanica NA Ltd.
Novacentrix
NOW Plastics
OASIS Alignment Services Inc.
Olbrich Machinery
Optimation Technology Inc.
Parkinson Technologies Inc.
PFFC–Paper, Film & Foil Converter
Polymer Science Inc.
Polypacks Industries
Polyplex Corp. Ltd.
Polytype America Corp., Converting Technology Systems
Precision Coatings Inc.
Premier Dies Corp.
Pres-On
PRIME UV Systems Inc.
Printpack Inc.
Protect-all Inc.
PRUFTECHNIK Service Inc.
Rayven Inc.
R.D. Specialties
Roche Diagnostics
Rochester Inst. of Technology
Rockwell Automation
Roethel GmbH & Co. KG
Roll Technology Corp.
Rol-Vac LP
Rotadyne
Royal Adhesives & Sealants
SAGE Industrial Sales Inc.
Saint-Gobain Performance Plastics
San Jose State Univ.
Shanghai Luxin
ShapedWire/Solon Specialty Wire
Sheldahl
Siemens Industry Inc.
Sierra Coating Technologies
Sigma Technologies Intl. Inc.
Sion Power Corp.
SKC Inc.
Solamatrix Inc.
Sonoco Products Co.
Southwall Technologies Inc.
Speedmet A.S. Ltd.
Spooner Industries Inc.
Stanford–An Accraply Co.
State Univ. of New York at Binghamton
Sun Chemical Corp.
Sung An Machinery Co. Ltd.
Super Film Ambalaj Sanayi ve Ticaret A.S.
Taghleef Industries LLC
Technical Coating Intl. Inc.
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Teel Plastics
Tekra Corp.
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thelamco inc.
Thermo Fisher Scientific
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Univ. of the West of Scotland
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Vacumet Corp.
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AIMCAL is all about sharing information to promote the growth of the industry.—Bob Burgess, DuPont Teijin Films, AIMCAL president 1998–2000

Past presidents

Year	Name	Company
1970–71	John Pireca	Dorrie Process Co.
1971–72	G. J. Monaghan	Celanese Plastics
1972–73	Joseph Wadlinger	Hy-Sil Mfg. Co.
1973–74	Mark Ungerer	FLEXcon Co.
1974–75	Lockhart Hicks	Du Pont Co.
1975–76	Walter Krauss	ICI Americas Inc.
1976–77	Colm O'Shea	John Dusenberry Co.
1977–78	Michael Sullivan	Dunmore Corp.
1978–79	James W. Powers	Lamotite Inc.
1979–80	Richard D. Vieth	Morton Chemical
1980–81	Ronald F. Caterino	King-Seely Thermos Co.
1981–82	John S. Reed	ICI Americas Inc.
1982–83	Robert C. Jackson	Lamotite
1983–84	Edward T. Monigan	Dunmore Corp.
1984–85	Frank Ianotte	Camvac
1985–86	Sherman Rounsville	Hoechst Celanese
1986–87	Norman Forand	Madico
1987–88	Lee Nield	Du Pont Co.
1988–89	Howard Chaphe	FLEXcon Co.
1989–90	Terry Carroll	Dunmore Corp.
1990–91	John Marcantonio	Leybold Technologies
1991–92	Robert Korowicki	Vacumet
1992–93	Harry Tenney	AlliedSignal
1993	John Robinson	Deposition Technologies
1993–94	David Smith	Rexham Custom
1994–95	Sven Sandblom	Faustel Inc.
1995–96	Chuck Larsen	Celplast Metallized Products
1996–98	William Long	ESK
1998–00	Bob Burgess	DuPont Teijin Films
2000–02	David Fletcher	Bekaert Specialty Films LLC
2002–04	Frank Sereno	PROMA Technologies
2004–06	Paolo Raugei	Galileo Vacuum Systems Inc.
2006–08	Bill Yoder	Lamart Corp.
2008–10	Mike Engel	FLEXcon

The best is yet to come.—Craig Sheppard, executive director of AIMCAL

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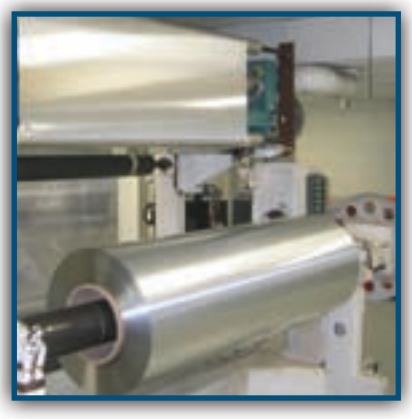

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A future for photovoltaics

TopMet 4450: Called the world's largest vacuum web coater, machine has Applied Materials' advanced HIRES high rate evaporator said to significantly improve productivity and throughput.

An expert takes a look at the ups and downs of vacuum web coating over the past decade, as well as what lies ahead.

By Dr. Charles Bishop, C.A. Bishop Consulting Ltd.

Some areas of vacuum web coating have progressed in the past decade, others have lagged behind. A hot topic 20 years ago was transparent barrier coatings. Silica and alumina coatings had been produced and evaluated for barrier performance, and it was predicted that an enormous amount of vacuum-deposited transparent barrier would be required.

Following this prediction, many research programs were started and completed with many different vacuum deposition processes and materials evaluated. A decade later the same predictions were heard, but the explosion of use of transparent vacuum-deposited barrier coatings still had not arrived.

A few machines were sold for the electron beam deposition or plasma-enhanced chemical vapor deposition of transparent barrier coatings, but the cost of the coatings was deemed too high by potential users, and the market growth never took place. In Japan, there was some production using induction-heated sources to deposit silica but only on a limited scale.

Hidden from view ten years ago, one company followed up a research paper presented at one of the International Web Coating Conferences organized by Bob Bakish and developed a method of oxidizing the depositing aluminum coating in a standard metallizer. This technique of using a modified resistance-heated aluminum evaporation metallizer to deposit transparent aluminum oxide coatings has become the new hope for producing transparent barrier coatings.

It is a technology that looks to offer transparent barrier coatings at a cost much closer to that of opaque aluminum metallized coatings. So again we hear predictions for a huge growth in transparent barrier coatings.

High barriers needed

Ten years ago the requirement for ultra-high-barrier coatings for organic displays had been identified, and it was established that a barrier performance six orders of magnitude better than for food packaging was required. This barrier performance target has proven difficult to achieve.

The reasons why the deposited metal, glass-like, or ceramic coatings fail to meet the bulk barrier properties are now much better understood. The effect of substrate quality on the barrier performance leads to the development of higher-performance substrates that have been heat stabilized, cleaned, and planarized. It has been shown that if you produce a clean, smooth, flat, high-surface-energy surface, a single-layer dense barrier coating can achieve ultra-barrier performance.

When the surface is not ideal, it is common for a polymer layer to be deposited in the vacuum system before the inorganic layer is deposited in order to produce a new smooth and clean surface. This polymer deposition process also can be used after the inorganic layer has been deposited, so it can protect the freshly deposited layer as well as fill in any defects in the inorganic coating.

So in the last ten years, we have moved from research laboratory exemplars to pilot production. However, the promises of product so far have been exaggerated; large quantities of material can still be difficult to achieve; and the costs are significantly higher than the display industry would like.

Although this in-vacuum polymer deposition process has been available for about 20 years, it has been massively underused. I suspect the patent position and commercial considerations actually prevented this technology from being developed and used much more

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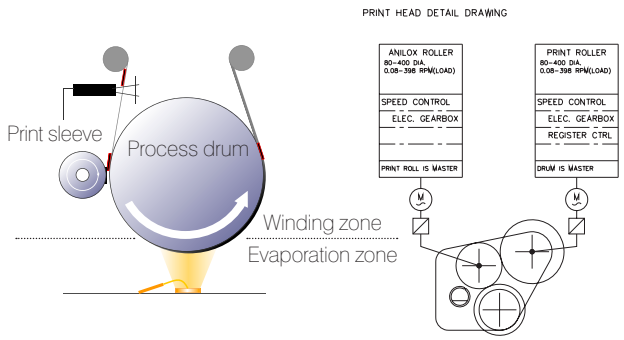


The development done by General Vacuum Equipment Ltd. of the basic flexo process for pattern printing to enable in-register in-vacuum pattern metallization.

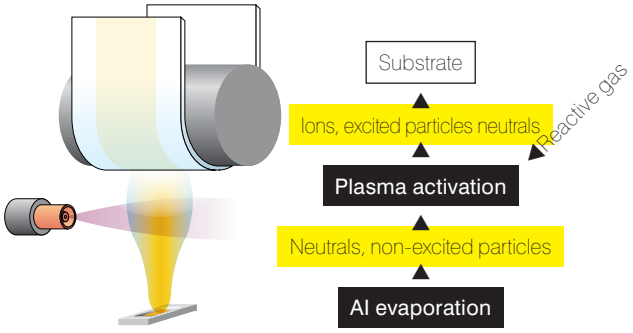
widely. Over the next ten years, I would expect that as the original patents run out, there will be an increased use of this technology, not only to enable higher-performance barrier production but as a way of developing multilayer optical and electronic materials.

This need for ultra-barrier transparent material has become even more urgent as the organic display market for flexible photovoltaics has appeared. The flexible photovoltaics (solar cells) are being scaled up, and as the process changes from research to pilot production and full production, there is an urgent need to produce modules and arrays that have a long life. It has been established that these materials also need to be encapsulated—and with a barrier material that is at the ultra-barrier type of performance.

These flexible photovoltaics include the copper indium diselenide type cells, but eventually these barrier materials will be needed for both organic and inorganic flexible photovoltaics.

It does not take a genius to see that one of the potentially large growth markets for vacuum-deposited coatings is in the area of barrier coatings. The rate of growth for transparent barrier food packaging coatings is good, with predictions for retortable transparent barrier materials expected to be in excess of 20%. However, the growth for both the organic display and the photovoltaic markets will dwarf this figure and will continue for much longer. The challenges also will be much greater as the performance must be so much better, and the price likely will be reduced considerably over the next few years.

With the markets so large, the competition will be considerable, and this too will help drive prices down.



The advanced AlOx process integrates Applied Materials' robust evaporator design, winding system, and in-line control system with a plasma-assisted depostion module developed by the Fraunhofer Inst. FEP in Dresden, Germany, for transparent coatings.

Machinery widens

Metallizers from previous generations still are recognizable, but while there have not been any radical step changes in the technology, there has been significant progress. Over the past ten years, metallizers have continued to get larger; the widest one now produced stands at 4.45 m wide and is able to metallize at speeds of 1,250 mpm. This width is approximately half the mill roll size for some film production lines. It will be interesting to see if anyone will take the leap to try to produce a metallizer that can use a full-width mill roll and gain the benefits of the film symmetry, reduced slitting, and cleaner film.

The use of printing technology to enable pattern metallization has continued development throughout the past ten years, with the latest improvement being the ability to produce metallized patterns in register with earlier embossing or printing. This simple use of in-register pattern metallizing is expected to open up opportunities for electronic applications. This technology works well for aluminum metallizing but is expected to need further development to enable the pattern deposition of thicker electronic coatings that may be deposited at slower speeds.

Seeking greater efficiency

Another area that attracts some interest has been in reducing power requirements. This has included different options for the boat shape that can reduce the volume of material and surface area, thus reducing the radiant heat loss and achieving the same temperature at lower power.

At least one system manufacturer offers an economy operating mode in which various parts of the system are switched off for periods of time to save energy. This is done without affecting the process speed or coating quality. As the aluminum deposition process is not particularly material-efficient—with some machines operating at material efficiency as low as 35% and the best around 60%—there has been some interest in a technology that has deposited aluminum onto metal foil at greater than 99% material efficiency.

This process uses a magnetically levitated molten pool of aluminum and a single exit from the source across the width of the substrate. This type of slot source or jet vapor source is being actively developed by several groups for a variety of different materials, but all have the common aim of producing highly uniform coatings with a high material efficiency.

The green factor grows

The ecological aspect of vacuum coating was not much of an issue ten years ago, but with sustainability and the move toward "green" materials of major importance today, this aspect is expected to grow in the foreseeable future.

There is confusion in this area, with some fighting for biodegradable films as being the best way to achieve environmental goals, while others want the use of biodegradable films restricted as it is believed that this encourages disposal rather

than recycling. Biodegradable films are being metallized by a number of companies, and this quantity is expected to increase while the debate continues.

What is clear is the expectation for packaging to continue to be reduced by either elimination of material layers or reduction in thickness. However, the performance of the packaging—whether mechanical or barrier—is expected to remain the same.

The sputtering sector

Sputter roll coating as a general business appears to be stable but has never quite achieved expectations. Ten years ago, there was a desire for more transparent conducting coated material, but there was a worldwide overcapacity for machines that could produce these coatings. The gap between the words and the reality was the cost and quality of the coatings.

In reactively depositing the indium tin oxide (ITO) coatings, there always was the possibility of arcing disrupting the conductivity of the coating, but as the coating was transparent irrespective of the conductivity, the ability to map the good parts and bad parts of any roll became a quality requirement. The difficulty of meeting some of the specifications and the slow rate of deposition meant that many of the coatings were too expensive, and so many potential users stayed with thin glass substrates. The advantage of converting to roll-to-roll transparent conducting substrates never was deemed compelling enough. Over the past ten years, this market continues to be lower than predicted. In recent years, there was a large price increase for indium targets, and the concern over diminishing resources has caused some companies to change strategy.

There is currently a great effort to find a low-cost transparent conducting coating to replace ITO. The most widely used alternative is probably aluminum zinc oxide (AZO). Both the aluminum and zinc are cheaper and more abundant than the indium.

Over the next decade, I would expect there will be a gradual move away from ITO toward AZO and other transparent conducting coatings. However, unless there is another large spike in the price of indium, I would expect this to take time since ITO generally offers superior performance, meaning compromises must be made to change to an alternative.

Powering up

Power supplies for sputtering have continued development to help address deposition problems associated with reactive deposition. Various arc suppression or management techniques have been developed that help production sources work arc-free for longer periods of time.

The more exciting development, however, has been the high-power impulse magnetron sputtering (HIPIMS), in which a

very high power is applied to the magnetron source for a very short time. This enables a very high ionization of the depositing material, and in turn, this enables denser coatings with more equiaxed crystal structures to be deposited.

The speed of pulsing and the change in the plasma characteristics can help improve the sputtering rate and uniformity as well as the adhesion and density of the deposited coatings. As this process becomes better understood and more widely available, there will be more roll-to-roll coating systems that will use the process.

Two other technologies that also will become more widely used for roll-to-roll coating are atomic layer deposition (ALD) and atmospheric plasma deposition. The first is being developed in two different ways, and both look as if they will result in production equipment within the next ten years.

Atmospheric plasma has been around for longer than ALD for roll coating machines and has the attraction of not requiring a vacuum system. Thus it was expected to produce lower-cost coatings. However, the cost of helium for the process and the limited deposition rate mean it has not yet delivered coatings to challenge those produced by vacuum deposition.

Ten years ago, roll-to-roll vacuum system manufacturing was dominated by the production of aluminum metallizers. This is no longer the case. With the explosion of the photovoltaic market, there have been a large number of startup companies requiring pilot and production machines to produce photovoltaics by roll-to-roll vacuum deposition.

Many of the photovoltaic materials require several vacuum coating machines, since some of the layers are sputtered and others evaporated. Also, between the layers there may be a scribing step.

With the economic crisis, the initial surge in requirement for these photovoltaic deposition machines has waned, and as the market becomes more cost-conscious and some companies fail, there may be a thriving second-hand machine market for some time. But this is only a short-term change; the market has not disappeared but has only been delayed.

It is expected that the dominant market for vacuum coating machines will be for photovoltaics and the barrier materials required to encapsulate them, as well as for organic displays.

To sum up, despite the general economic world gloom and the fact that metallizing will remain a challenging market with relatively low margins, I would say the opportunities for the vacuum coating market as a whole have never been brighter.

Dr. Charles A Bishop, C. Eng., is principal of C.A. Bishop Consulting Ltd., Shepshed, Leices, UK. He is a member of AIMCAL's Technical Advisory Panel and has published more than 50 technical papers and holds five patents. He can be reached at cabishopconsulting@cabuk1.co.uk.

Trends in technology

The converting industry has never stood still when it comes to technology. The next decade will be no exception.

By Edward D. Cohen, Edward D. Cohen Consulting Inc.

The converting industry and some of its processes are 100 years old or more. Despite that, the industry has remained dynamic and competitive by continuously incorporating new process and product technology to improve quality, reduce costs, and develop new products.

Examples of technology advances in the past decade include the following:

- Increased use of in-line instruments to control quality and reduce costs, replacing off-line evaluation methods
- Development of fundamental process engineering science concepts, which have been used to improve the design of equipment coating applicators and the behavior of materials during handling and processing
- The development of flame, electrical-discharge, and plasma technology to modify substrate properties, leading to improvements in adhesion, product performance, and coating quality by improving surface wettability
- The widespread use of the Internet in all aspects of the business
- The development and increased use of pre-metered coating methods

Moving forward

Evolutionary advances will be made in the above technologies during the next ten years, leading to improved quality and productivity at lower purchase prices. In addition, there is the potential for breakthrough technologies in the following areas:

- Low-energy drying systems
- Coating technologies for coating uniform thin layers and low-solvent-level coating solutions
- Low-cost, reliable alternative energy sources
- New processes to reduce environmental contaminants
- Cloud computing via the Internet
- New raw materials based on renewable resources and not on fossil fuels
- Automated coater lines

Computer gains continue

There will be significant advances in computer and information technology. Computer data processing rates and data storage capability will continue to increase, hardware purchase costs will be reduced, and more processes will be automated.

"Cloud computing" is an emerging technology that utilizes remote servers and the Internet to maintain all data and applications. All processing is done via a browser on a pay-as-you-go basis. As a result, users do not have to buy the servers or software for their applications and do not have to maintain their own systems. This also will increase the technical capability of companies that do not have resources for their own system.

Large amounts of process data can be stored and analyzed with sophisticated software. Engineers and R&D can have access to programs that calculate and optimize energy consumption, model dryers, and web transport systems.

This should improve quality at a low cost, but in order to successfully achieve this goal, all personnel will have to be proficient in utilizing computer and information technology.

On-line QC, measurement

The current use of on-line defect inspection systems is relatively low—20% in the US—but its use will expand in the coming decade. These systems are needed to determine defects rapidly and accurately on the product as it is coated. It is a necessary technology to improve quality and reduce scrap losses.

The next generation's on-line inspectors will have improved optics and systems to detect smaller defects at higher line speeds. They may be able to check for additional properties such as color, surface roughness, etc. Artificial intelligence systems will be included to characterize defects and control process variables that influence defects. Cloud computing will give on-line inspection system units increased computational power, large data storage capability, and powerful analytical capability.

On-line coating weight measurement is another critical system that can improve product uniformity and lower costs by reducing the amount of out-of-limits product that must be scrapped. The use of this system will expand from the current 50% to a much higher level. Improvements in computer and electronics technology will

lead to lower costs and improved precision. Nuclear gauging devices will be eliminated due to safety and environmental concerns, replaced by advances in infrared (IR) and laser technology.

There is also a need to characterize the coating solution before coating application with in-line sensors to determine if there are any contaminants, bubbles, dirt, or particles in the solution. The coating application would not start until the coating is free of defects. In-line viscosity measurement and control also is needed to ensure uniform coating weight and coating quality.

Coater performance capabilities	Line speed 29–1,000 fpm
Quality yields >90%	Improved process control
Energy costs >5% of total cost	Coating runs 0.5–2,000,000 sq ft
Coating thickness 0.48–4 mils	Product change time 10 ft
Yield & productivity are Independent of volume	
Quick change coating station: Roll premetered and 100% solids	

Coater enabling technologies in 2010	
Reduced energy consumption	Dryer optimization
Minimum energy mix and dry	Heat recovery drying and scrap
Reduced solvent loads: Concentrated solutions, Low latent heat of vaporization, 100% solids coating	
On-line quality measurement	
Dryer: Defect inspection, Coating weight, Performance properties	
Coating solutions: Bubbles and dirt, Particle size	
Viscosity and surface tensions: Undercoating	
Artificial intelligence systems: Controls loops to reduce defects & optimize process	
Coating application	Discontinuous coatings
Rapid change	Custom design
Increased fabrication precision	Multi-temperature
Sensors for gap, roundness	Automated
Multiple methods: Solution, hot melt, inkjet	
Dryer	Multiple techniques
Optimize for low energy consumption: Recycle air; Continuous optimization–Additional sensors	
Rapid equilibrium: Rapid acting control systems; Model-based control loops	
Computer & information technology	
Monitor & control entire process	Simplified analysis capability
Increased process rate & storage	Automated control, all systems
Internet computing, "cloud"	Advanced modeling
Substrate	Surface treatment: Adhesion wettability clean surface
On-line testing	Non-oil-based compositions
Safety & environmental	
Solvent recovery	Automated coater
Scrap recovery	Environmentally on standards

On the topic of measurement, there are a number of new markets and technologies in which coatings are getting very thin, sometimes in the nanometer range. Breakthrough measurement technology will be required to meet the gauging needs of the new low-coating-weight products under development.

While current measurement systems do not function in this range, potential methods could be ellipsometers, interferometers, and combination detectors.

The energy factor

Because of high energy costs and concern about reliable supplies, reduced energy consumption is mandatory in the converting industry. Many programs in this area will be required for success; a single technology application will not be sufficient.

Below are technologies that will need to be implemented to achieve energy reductions:

- Change the approach to product formulation and manufacturing to consider energy costs. The energy cost of cents per square foot will be a critical evaluation parameter as well as performance properties, yield, and quality. New software will be needed to calculate energy consumption rapidly along with a database for costs.
- Reduce drying load by using solvents with low heat of evaporation and concentrating the percent solids of coating solution.
- Eliminate solvents for lower drying load and utilize hot melt coating. New application methods to apply thinner layers will be needed.
- Reduce solution preparation energy by minimizing time and temperature of mixing.
- Reduce solution delivery system energy by holding solution at low temperature and heat immediately prior to coating application.
- Recycle all scrap material to create energy.
- Reduce energy consumption during coating stops. This will require rapid-acting control systems to reduce dryer temperature quickly when the coater stops and to attain equilibrium rapidly when the coater starts.
- Use of software programs to optimize drying profiles for lowest energy costs.
- Increase energy efficiency, which is a must for all coating line components.

What about low volumes?

There are several new products under development, including smart labels, RFID labels, and other forms of printable electronics, that will have a high value in use but will be produced at much lower volumes than the majority of the current products. In addition, volumes of current product lines will drop as the use of the Internet for communication increases.

In order to accommodate these small-volume products, new technology will be needed. Startup time on the coating line must be minimized, or startup losses will be too high for a competitive cost. Technologies to reduce startup times will include hardware for rapid change of coating methods; improved solution processing to reduce bubbles and contamination defects on startup; and new process control instruments and control logic to arrive at equilibrium conditions rapidly.

Another approach is to develop automated coating lines specifically designed for low-volume products. It may be cheaper to use a new machine than to modify existing hardware.

Tomorrow's applicators

The focus on the coating applicator system in the near future will be to provide defect-free product for both short and long coating campaigns and to develop technology for coating high quality, thin coating layers and wet layers <0.48 mils.

What will accomplish this will be new hardware systems to minimize bubbles and reduce streaks and discrete defects. Narrow gaps between the coating applicator and backup roll are critical to good coating quality and are required to optimize coating quality for thinner products.

However, existing applicators and support hardware cannot maintain the low gaps needed. What will be required to meet this need are improved precision of applicator and coater roll tolerances and an upgraded coating station to hold the tighter tolerances.

Improved measurement techniques to monitor gap continuously will be developed and will be used for control loop. Fundamental engineering studies will be needed to define key process parameters for both thin liquids and 100% solids coating so improved hardware can be designed and built.

Methods of the future

In regard to coating methods, slot die usage will increase and the use of roll coatings will decrease. The advantages of the slot die over roll coating are improved coverage uniformity; excellent coating quality; reduced solvent emission due to minimal exposure of coating solution to atmosphere; multilayer capability; and the ability to produce discrete coatings.

In addition, the development of improved coating technology for 100% nonvolatile systems will continue. Not having to remove solvent will considerably reduce process energy requirements.

New product structures will require discrete coating and multiple layers, as well as continuous coating. To meet these needs, improved digital and inkjet coating methods will be needed along with multiple layer slot dies.

Drying technology

One area that probably will not see any significant technology advances is drying. That is because, due to past developments, there already are several systems in use: hot air impingement, single side, floater, festoon, IR, and microwave. Drying configurations are available to meet current needs; there also are models to simulate drying conditions so drying profiles can be optimized.

The drying process is the largest consumer of energy in the coating process. Because of this, hardware technology developments have been implemented to reduce coater energy requirements, and extensive use of this technology will continue.

In summary, converting technology developments over the past decade have paved the way for the future. In the next ten years, we will see the industry build on those developments, as well as find new solutions to problems we may not yet foresee.

Edward D. Cohen is a technical consultant for AIMCAL. He has 40+ years of experience in research and manufacturing technology. Contact him at 480-836-9452; cohened146@aol.com.

The following people provided input for this article, Tim Potts, Dark Field Technologies; Hector Marchand, NDC Infrared Engineering; Ed Gutoff, consultant; Ted Lightfoot, DuPont; Tom Giles, Aspect Automation.

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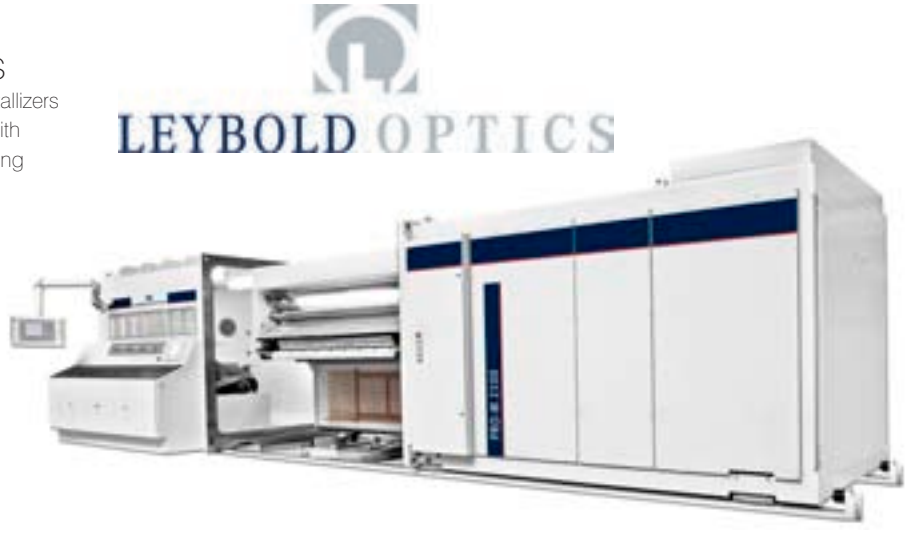

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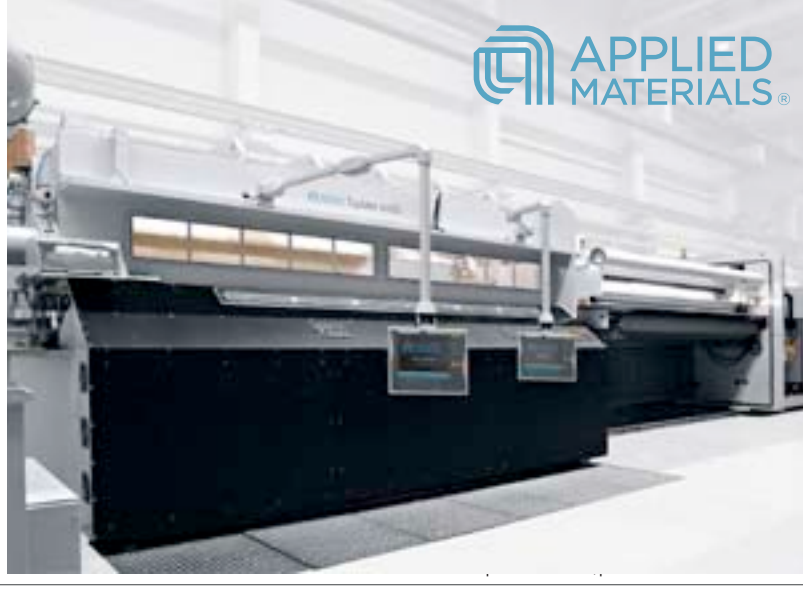

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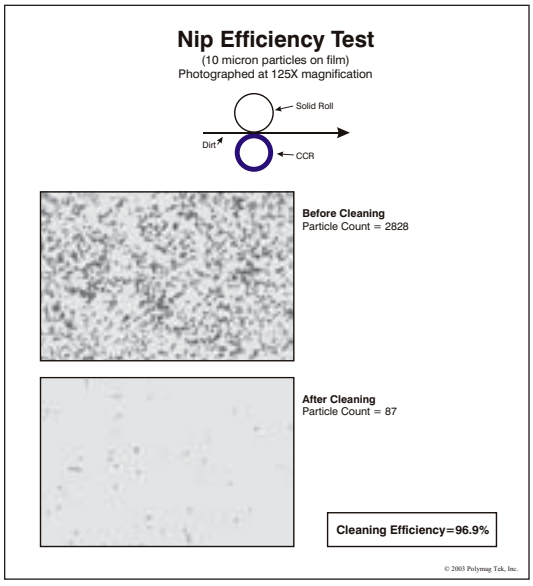

Polymag® Tek Manufactures Systems

Polymag® Tek Inc., incorporated in 1994, is a US based company that specializes in the design and manufacture of innovative sheet, web and process roll cleaning equipment for the printing, coating, laminating, flexible packaging, electronic and solar industries. The Polymag® Product Portfolio includes web cleaners, sheet cleaners, process roll cleaners, adhesive tape rolls and Polymag® Blue Contact Cleaning Rolls (CCRs). Please visit our website for all product information.

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Jetrion 4830 UV Inkjet System

EFI's Jetrion 4830 is a full-color, narrow-web digital press for run lengths of 50,000 labels and beyond. It prints web widths of up to 9" and up to 8.3" wide. With print speeds up to 120 fpm and grayscale printing capability, it's perfect for meeting the production and image quality demands of primary labels, as well as secondary and industrial labels or flexible packaging.

EFI Jetrion
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Pearl Technologies, Inc.

A quarter century of innovations have made Pearl a leader in the blown film and flexible packaging industries. We offer a complete line of blown film equipment enhancements that enable customers to achieve greater outputs and better film quality, while reducing maintenance and downtime. Pearl also designs and builds high-speed custom machine attachments for punching holes, perforating and slitting. Count on Pearl to make it better!

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