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# Inkjet Printing Solder Mask

by **Barry Matties and Pete Starkey**

I-CONNECT007

Known for their film-based products, Agfa-Gevaert has turned its focus to the difficult task of inkjet printing the solder mask by partnering with solder mask expert Electra Polymers. Sitting down with Frank Louwet and Mariana Van Dam of Agfa Specialty Products, I-Connect007 Publisher Barry Matties and Technical Editor Pete Starkey learn more about the partnership and where they currently stand in the development of what will be a definite game changer.

**Matties:** Frank, you're a part of the Agfa Specialty Products group, and the three areas that you're covering are Advanced Coating and Chemicals, Functional Foils and Classics. Tell us a little bit about the Classics.

**Louwet:** Classics are based on our core photosensitive Ag technology and contain three applications: Aerial, Microfilm and NDT, a film for non-destructive testing. This latter is an X-ray film used in industrial applications for checking weldings in pipelines and airplane engines.

**Matties:** And what about the functional foils?

**Louwet:** The Agfa functional foils business is based on our in-house capability of producing and coating mainly polyester films. It can be done all in one place. Main application areas for these functionalized polyester films are media for security printing, synthetic paper and back sheets for PV. SYNAPSTM is the trade name for this synthetic paper. This high-duty polyester print medium is used for menu printing, manuals, advertising or name cards.

**Matties:** The area that we're talking about is advanced coatings & chemicals, producing and commercializing films and inkjet inks for the PCB and chemical milling industry. You said you have 40% of the film market, which is substantial. That's quite an accomplishment.

**Louwet:** We have good products combined with a good sales and service organization. Agfa Materials has its own sales organizations in Europe, China, Taiwan, Korea, Japan, South East Asia and the U.S. The local sales teams have good technological capabilities, so they can give excellent service and support to customers. Customers appreciate this. We have very good inroads into this market and are now also developing UV inkjet inks to digitalize some of the



Frank Louwet

production steps as an alternative for the traditional analogue technology. We have a range of legend inks and etch resist already commercially available.

**Van Dam:** Agfa holds a wide experience in inkjet ink development for different graphic applications. We have now an integrated bigger team working on inkjet inks both for graphics and PCB.

**Matties:** *So you aren't doing any equipment. You are a materials supplier only?*

**Louwet:** Indeed, Agfa Materials does only materials. Our Agfa Graphic team does also equipment for graphics applications but we do not. It is both a strength and a weakness. A weakness is that Agfa Materials cannot offer the full solution to the customer. The strength is of course that we can interact with many printer manufacturers and have open discussions with them. The PCB industry does not like to be bound to a single source for hardware and ink.

Our printer partners are very important. A solution has to be offered to the customer. This cannot be done with the ink only; you need strong printer manufacturers to go along.

**Matties:** *As we've been talking about your products, the etch resist and legend ink, I noticed that you are compatible and approved with most available inkjet equipment. That's a smart strategy.*

**Louwet:** We started with the development of the legend inks. By now it's our fourth generation. It is not always spot on from the first time, but you learn a lot for the next generations and for the next products, like etch resist and solder mask.

**Matties:** *The area of films and inks for the PCB industry was screen printing back in 1945, all the way to 2020, which will be additive inkjet printing. This is where we're not going to be etching boards at all, but we're just going to be printing our circuits?*

**Louwet:** Yes, but 2020 is probably too optimistic. Basically, the PCB industry has now accepted additive legend IJ printing; etch resist IJ printing will be next, followed by IJ solder mask. The ultimate next step is of course that you print also the metal. For that Agfa developed a nanoparticle ink. With our extensive background in silver technology, Agfa has a proprietary nanoparticle silver dispersion which has been formulated for screen-printing inks. We are now also developing inkjet inks that can be used in a PCB environment.

**Matties:** *Is there a lot of interest in the industry for this product right now? From a visionary point of view, are fabricators coming to you and saying, "What do you have coming for this kind of process?" Or do they even care?*

**Louwet:** Yes, there are players that are interested and are coming to us.

**Matties:** *Is it small scale at this point?*

**Louwet:** It's small scale, but there are bigger companies doing some applications today

where they want to replace the etching/stripping of the copper by printing of silver. And of course, there's already a lot of Ag screen printing in the printed electronics market today.

**Matties:** *In the realm of what we're looking at here, what's the greatest challenge? Whether it's in inkjet or film for the industry today, what are the greatest challenges out there for PCB fabricators? What are they really struggling with in this area? Imaging? Film? Or is it just an evolutionary product?*

**Van Dam:** I think it's certain that the industry is under pressure because of cost.

**Matties:** *Well, cost is always a pressure, and from a technology standpoint, speed is always a pressure.*

**Louwet:** And speaking in the sense of speed, not per board, but in getting the question from a customer and delivering the PCB board is also part of it, and of course the environmental impact.

**Matties:** *What sort of environmental impact do you have?*

**Van Dam:** With the inkjet, you have a lot less chemistry.

**Matties:** *So you reduce the waste, and setup is so much easier too.*

**Van Dam:** If you look at the etch resist, just as an example, and compare with the traditional process. You start from the laminate, then you have to apply your dry film which you need to image. For that you have to prepare the photo tool, then expose and develop. Then follows etching and stripping. If you use inkjet technology, you print immediately the pattern and then etch and strip. So that's 10 square meters versus 100 square meters and one person versus three to five people.

**Matties:** *What keeps people from throwing the old method away and just turning this on, if the value is so great? You eliminate a lot of equipment, a*

*lot of labor and cycle time. Why do people still do that?*

**Louwet:** The main reason why it is not there yet is that the right inkjet technology was not yet available. But the printhead development is going to smaller picoliter droplets and higher frequency jetting. So they can really jet at high speeds and at high resolution now. It will come very soon.

**Matties:** *So it is mostly a speed issue?*

**Louwet:** It's a speed issue, but also resolution.

**Matties:** *And you've got the resolution solved?*

**Van Dam:** The resolution is more on the equipment side, and there has been a big evolution in recent months.

**Matties:** *So the speed issue, how do we resolve that?*

**Louwet:** Of course, there is a tradeoff between the traditional process and the inkjet process with respect to volume. At the start, we are mainly targeting the prototype shops in North America and Europe. But even in China, they are thinking of this new production method to go digital with inkjet.

**Matties:** *I'm wondering what the barrier to entry is? When you look at the inkjet all the way through the process, it seems like we're so close. How long before the speed issue is resolved and we see this in high-volume production manufacturing?*

**Van Dam:** The printer integrators are building machines with more heads as we speak, to allow higher volumes.

**Matties:** *Are you working with equipment developers to say, "We want it faster. Here's what we want?"*

**Van Dam:** Yes, we have very close relationships with them.

**Matties:** *It just seems like this could be something we could turn on today. The company that's*

*serious about owning the high-volume production for this...it just doesn't seem like that big of a technical challenge to me from my limited point of view. That's why I'm asking what you think. What's stopping us?*

**Van Dam:** We believe it's going to take off.

**Matties:** *What should a PCB fabricator know that we haven't talked about regarding this technology?*

**Louwet:** The next step is the inkjet solder mask.

**Matties:** *Let's talk about that.*

**Louwet:** It was announced last year at production. We decided to go in a joint development with Electra Polymers from the UK. Electra Polymers is an established solder mask supplier in the PCB industry. Agfa understands the inkjet business. So we decided, let's put our efforts together. What you see here is our first prototype, which we are testing with several printer manufacturers. This material has passed all the electrical tests. UL is also okay. You see here the nickel-gold finish, which is a very critical one. It is working quite well; the adhesion is good. Of course, there are still some issues that we have to solve. It is important to be sure that all the properties are OK before we go commercial.

**Matties:** *Tell me about the curing of your material. Is it high speed?*

**Van Dam:** Yes, it's UV, but then it gets a thermal post cure.

**Matties:** *Do you still bake it?*

**Van Dam:** Yes, for the solder mask and the legend ink. For the etch resist you normally need only the UV cure.

**Louwet:** Our goal is to show something more at IPC APEX EXPO 2017 in February. Today we are at the stage where we are starting to talk to end customers with a kind of three-way cooperation between AGFA, the printer manufacturer and the end customer.



Mariana Van Dam

**Pete Starkey:** *The only question I have regarding this is that I see that the conductors are black. Have you done a special treatment to improve the adhesion of the material?*

**Van Dam:** We tested several pretreatments, and this one is a type of micro-etch.

**Louwet:** We have been working with a team of 10 people very intensively on this and of maybe 15 different concepts that we have, a few survived and this is one of them; the adhesion of copper is of course an important part.

**Starkey:** *From a personal point of view, I'm very excited. The real, working inkjet solder mask, is something I've been waiting 15 years for.*

**Louwet:** It's still to be proven, but we are quite optimistic.

**Van Dam:** It looks very promising.

**Matties:** *What about the cost of the product? How do you think that's going to run?*

**Louwet:** We know that we have to be competitive with this inkjet technology.

**Van Dam:** The ink itself will be more expensive than the traditional ones, but there are a lot of savings in the overall production process. And of course, a digital additive process offers also a lot of other valuable advantages.

**Louwet:** What I can say is that we have been discussing this with some end customers and they have calculated some target prices and we are in the same ballpark.

**Matties:** *That's good, so it's not outrageous. Here's the other thing. I would think every company that provides mask is looking for technology like this, and there might be a lot of choices and competitors for this product. How do you differentiate yourself?*

**Louwet:** What's important here is to be first. A lot of companies are really thinking of digital production. It's important to be there now and to be designing with them.

**Matties:** *You said you started the development of this product about a year ago?*

**Louwet:** Yes, but of course, we've built a lot on the legend ink and the etch resist experience.

**Matties:** *Is the time to develop the product in line with what you thought it would take?*

**Louwet:** It's going faster than we expected.

**Matties:** *You're about a year into it, and you're close to going into market now?*

**Louwet:** It will take another year before we do a full commercial launch.

**Matties:** *You're going to partner with some beta sites, I'd imagine. We'd be interested in doing the case studies for the beta sites as you follow this process along, if that's acceptable. Thanks for taking time to talk with us.*

**Louwet:** Thank you. PCB

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## 'Knitted Muscles' Provide Power

Researchers have coated fabric with an electroactive material, giving it the ability to actuate in the same way as muscle fibres. This opens new opportunities to design "textile muscles" that could, for example, be incorporated into clothes, making it easier for people with disabilities to move. The study, which has been carried out by researchers at Linköping University and the University of Borås in Sweden, has been published in *Science Advances*.

Developments in robot technology and prostheses have been rapid, due to technological breakthroughs. For example, devices known as exoskeletons, which act as an external skeleton and muscles, have been developed to reinforce a person's own mobility.



"Enormous and impressive advances have been made in the development of exoskeletons, which enable people with disabilities to walk again. But the existing technology looks like rigid robotic suits. It is our dream to create exoskeletons resembling items of clothing, such as "running tights" that you can wear under your normal clothes. This may make it easier for older persons and those with impaired mobility to walk," says Edwin Jager, associate professor at Division of Sensor and Actuator Systems, Linköping University.

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#### EDITORIAL CONTACT

**Patty Goldman**

[patty@icconnect007.com](mailto:patty@icconnect007.com)

+1 724.299.8633 GMT-4

#### SALES CONTACT

**Barb Hockaday**

[barb@icconnect007.com](mailto:barb@icconnect007.com)

+1 916 365-1727 GMT-7



[www.icconnect007.com](http://www.icconnect007.com)