Scalability as a key to success

In emerging technologies like organic and printed electronics, laboratory lines need to be transferable to mass production says Miguel Friedrich of nTact

In sports there is the saying "never change a winning team", a platitude frequently used in all the right and wrong moments. But still this doesn't mean that it doesn't have a kernel of truth. One example for this might be the technology of the American company nTact, a dba of FAS Holdings Group, LLC, based in Dallas, Texas. This company, which specialises in coating systems and integrated process solutions, is following an approach in the organic and printed electronics industry that it already benefited from many years ago in the LCD display industry, as Miguel Friedrich, vice president sales, explains during an interview with OPE journal.

"When our company first developed extrusion or slot die coating, we adapted elements of a typical slot die roll to roll process to a sheet to sheet process for microelectronic applications. The first application we pioneered in that area was for LCD production," explains Friedrich. "One of the keys to success for our technology back in the early nineties, apart from its very good material utilisation, was that it provided a scalable technology to the LCD industry. When we first started working in this area, the substrates were very small, and of the order of 5 or 10cm^2. Now in LCD production this technology has been scaled to coating panels which are roughly 2.5 to 3m in size." Today the experts at nTact reckon that this proven scalability will be a key factor for their products' success in the organic and printed electronics industry.

Different demands

Although the move into the new industry came pretty naturally, as the display market was moving towards organic electronic applications, there were still some challenges to overcome. One of the biggest was the different coating thicknesses.

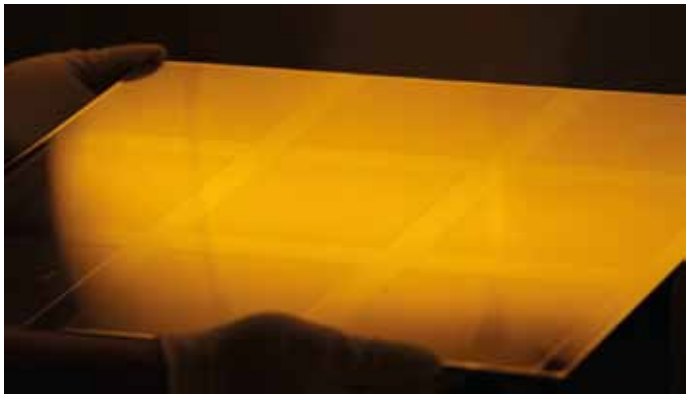
"In LCD we were depositing layers in the one to two micron range at the low end," says Friedrich. "When we were starting to work with OLEDs for example we had to deposit layers as thin as 20nm and we also needed very high uniformity levels." Apart from that were other challenges such as the organic solvents like toluene that are used in many of these applications and have very fast evaporation rates.

Driven by market needs, nTact developed its technologies of Selective Area Slot-Die Coating and Selective Removal.

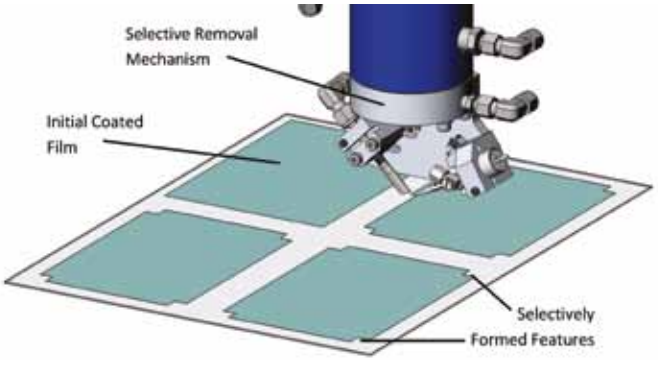
Coat and remove

The Selective Coating method uses a specially designed extrusion coating die with multiple openings to define coated and uncoated areas (stripes) across the width of the substrate. According to nTact the stripe coating is combined with the ability to precisely start and stop the coating multiple times down the length of the substrate. "We achieve that ability through a very precise control of the coating parameters including the dispense rate for which we use a very precise pumping mechanism," says Friedrich. "And of course very high accuracy components and control methods are needed to achieve this and to get a very clean leading and trailing edge for each coated area."

Usually the coated stripes are similar in width and spacing; still, asymmetrical arrangements are also possible. The stripe array is generally designed to coat the desired width on the final device, plus a small amount of extra width on each side. "The extra width, or 'side edge exclusion', is needed to compensate for thickness non-uniformities at the edge of the coating and for potential overlay inaccuracies where multiple layers must



An example for patterned coatings



The Selective Removal technology can be used to create complex shapes

Miguel Friedrich

be aligned," explains Friedrich. "And here the Selective Removal, which implements a proprietary mechanism to remove portions of the coating material immediately after the deposition, comes into play."

This removal mechanism can, for example, be used to create complex, non-rectilinear shapes of coated material. It consists of a nozzle that uses a solvent that is compatible with the coating fluid, to dissolve the coated layer, while simultaneously removing the solution from the surface of the substrate. The nozzle doesn't touch the substrate, and the height above the surface, along with the x-axis and y-axis motion of the device, is controlled to ensure process reliability and repeatability.

"For this technology it is really important to have the right solvent for each coating," states Friedrich. "There may be some applications where this removal technology is not applicable. But it could prove to be ideal for applications requiring 'macro' level patterning of about 1mm or greater." The fact that the system removes only what is required and leaves the rest untouched is achieved by the accuracy of the mechanism as Friedrich points out: "The combination of the high precision components, right setup and fully programmable process recipe is what gives us very precise control of the stream and the way the solution is removed with the vacuum mechanism."

The removed material is contained in a vessel for subsequent disposal. The amount of solvent utilised in this process is said to be very low. Still, the exact amount will depend on a number of different factors like the type of the pattern or the thickness of film being removed for example.

Know your applications

According to nTact, the company's innovations open completely new fields of application. "Currently extrusion coating for the most part is being used to apply single, continuous layers of material and is overlooked as a means of producing patterned coatings," reports Friedrich. "But our Selective Coating method has been successfully demonstrated to directly apply a patterned coating while maintaining a high level of film thickness uniformity and smoothness and we can achieve these results with a wider range of material viscosity and film thicknesses than competing methods, such as inkjet and spray coating."

Another field where Friedrich sees great opportunities for his company's technology is in printed electronics, where the deposition of simple shapes and macro patterns is required and these patterns cannot directly or effectively be produced by the initial coating method. Right now these shapes are typically created by using laser ablation or photolithography. For some applications, these methods according to the expert could add unnecessary costs and complexity to the fabrication process. He thinks the Selective Removal technology is better suited to create some of the larger, less complex shapes that are currently formed using other processes.

Although many things in the area of organic and printed electronics are still in the state of development and far from conquering markets around the world, it already plays an important role in nTact's business plan. "The organic and printed electronics industry is very important to us and we see applications such as OLED (display and lighting), and various photovoltaic and printed battery technologies playing a significant role in the future of our company," concludes Friedrich. "With a market forecast of nearly $50 billion in the next five years, nTact sees this as one of the next up and coming industries and a great opportunity for their slot-die coating technology to have a significant impact."