SCREEN PRINTING ELECTRONICS

Examining changes and developments in the electronics screen-printing industry, Fernando Zicarelli explains why he believes that mesh making technology has a future with electronic component manufacturers

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I have been working in the electronics screen-printing industry for over 30 years and I have seen many people discard our technology as antiquated and out of tune with the current technological demands. Funny thing, I think the same people who made these statements were either ready to retire, or unwilling to learn that mesh-making technology has been bringing new advances capable of (by today's standards) making it the selected technology for component manufacturing, such as LTCCs [low temperature co-fired ceramic], MLCCs [multi-layer ceramic chips], PV [photovoltaic] and hybrid thick film circuits.

There is a reason why screen printing has been around for such a long time; it is a mature technology that has been polished for many decades; a technology where there are many variables reacting with each other and, at the same time, with no single controlling variable.

INFLUENTIAL VARIABLES

We at Asada Mesh believe that there are four variables that play a major role in the screen-printing process:

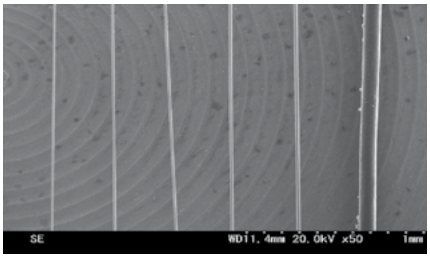
- Squeegee speed – adjust to achieve smooth peel-off
- Squeegee angle – affects filling of the paste
- Printing pressure – equally stressed on the surface, and the EOM dispersion
- Snap-off distance – $^{1}/_{300}$ the internal frame size

The importance of squeegee variables is something that can be overlooked; shops want to make products quickly and at times they realise that 'faster' is no longer printing well. There are several squeegee variables that you should consider when deciding to increase the speed of printing:

a. Viscosity of the paste
b. Squeegee angle of attack
c. Squeegee edge shape and durometer

Printing pressure is extremely important as it dictates whether the angle of attack of the squeegee is too narrow. In our experience, the narrower the squeegee angle of attack, the more paste is ahead of the squeegee edge and this paste arrives at the emulsion openings far sooner than the actual gasketing takes place. Unfortunately, in most cases this causes severe paste spread.

Snap-off distance is usually calculated by dividing the internal size of the frame by 300; so, if your frame is 300mm x 300mm in ID, then your proper snap-off distance should be 1mm. You should use this 1mm distance as the start point and make small increments until the print quality is to your liking.



Asada Mesh wires ranging from 11-micron to hair size

"Asada Mesh has launched an HSD mesh line to help control layer placement to ensure layer alignment"

ADVANTAGES OF ASADA MESH' STAINLESS-STEEL MESH

In this article, I am highlighting the advantages of the Asada Mesh' stainless-steel mesh technology over other technologies with just a few bullet points:

- Screen printing is an additive process for the creation of electronic circuitry which works well on various substrate types like paper, plastics, ceramics, glass, textiles and silicon.
- It provides customers the ability to obtain thicker ink deposits in far fewer passes versus inkjet or flexo/gravure. It can control the thickness laydown by adjusting only one parameter, the calendering thickness of the mesh without having to play or adjust any other variable.
- Screen printing has a very broad base of manufacturers and process knowledge which continually update the technology for new and current applications.
- Improvements in substrate, paste and equipment technologies fare well with the advancements in mesh and emulsion technology.
- Ultra-fine stainless-steel wire meshes are more widely available with different open areas. The wire technology has reached 11 microns in diameter and soon we will have the very first sub-10 micron wire diameters and 70% open area. These two advances are going to enable our beloved technology to achieve another level of miniaturisation, an even thinner deposit and sub-10 micron features.
- Screen printing has benefited from advances in emulsion technology as well; the possibility of thinner and flatter emulsion technology has allowed for better edge definition.

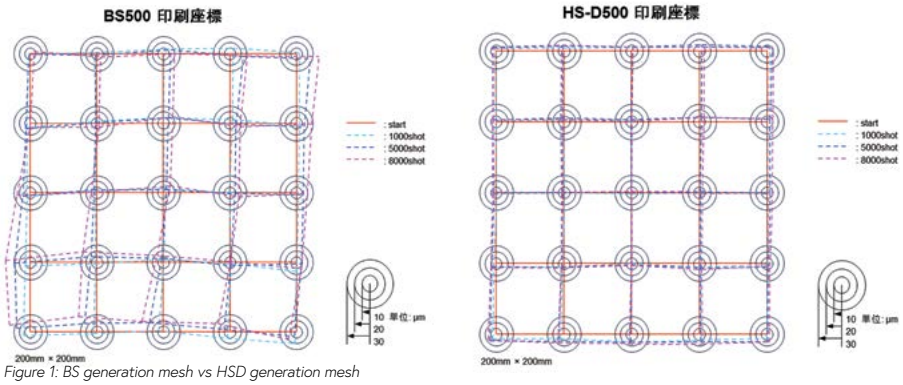
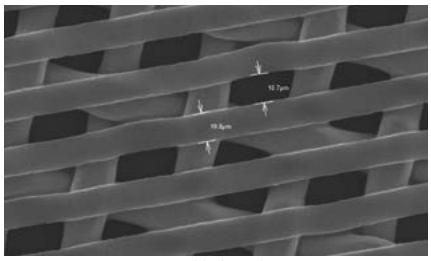
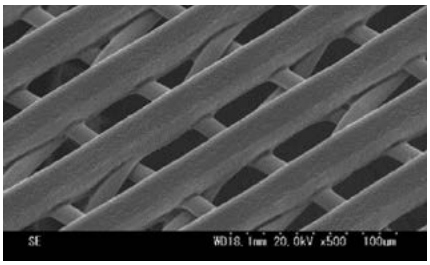


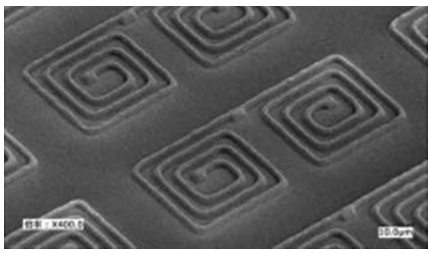
Figure 1: BS generation mesh vs HSD generation mesh

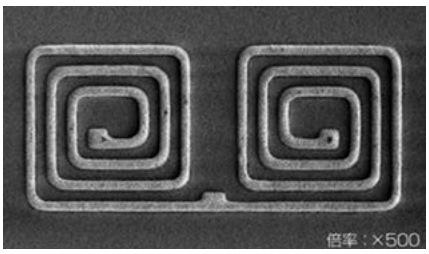


AZOCOL Z177FL on 500-16 black mesh (3-micron EOM)



20-micron opening – SHS-520-11





15-micron line + 18-micron spacing using Asada Mesh HSR-500-13 CL-22-micron

- Printing equipment has allowed for more precise visual alignment technology and for the possibility of printing larger and finer circuitry. The actual state of the art lab feature size is around 10–15 microns and 30–50 for some mass production of industries like MLCC and PV.

QUESTION...

So why should we continue to use this technology for printed electronics?

Beside the bullet points mentioned earlier, the current printed electronic devices in the arena of flexible printed electronics are constantly being delayed by untested emerging technologies. There is a broad knowledge base in screen printing that has finally come together to fight for our beloved industry.

Electronic component manufacturers who were looking at screen printing as their potential manufacturing process have been distracted so many times and unfortunately this industry has not been taking off because of it.

Constant advances in substrate, paste and equipment alongside the advances in mesh technology have allowed us to reach unprecedented levels of feature size, layer thickness and alignment accuracy. Screen printing can print different material types like dielectric layers, resistors, capacitors, inductors, text and even protecting layers by changing only the screen tool itself. Multi-layer circuits can now be connected from level to level just as has been done for over 50 years.

"Asada Mesh has launched an HSD mesh line to help control layer placement to ensure layer alignment"

ALIGNMENT AND ENDURANCE

Alignment between layers is another key issue that you should consider when deciding which manufacturing process to use – as the devices are being made in larger quantities, the meshes are also supposed to help in this area. Asada Mesh is believed to be the only company that has investigated this important issue; we launched our HSD mesh line to help control the layer placement to ensure layer alignment. Made with a special alloy, this mesh can sustain larger snap-off distances and still control the positional accuracy of the different layers. **Figure 1** illustrates a comparison between the first generation of our BS mesh and the HSD generation. Over the course of 8k impressions, you can see how the location of each zone has moved.

It is important to remember that feature placement will become a key factor in multi-layer printed electronics devices and as the substrate sizes grow, you must look for a manufacturing process capable of growing a well without the loss of placement accuracy. Our HSD meshes were designed to take care of this issue.

HSD meshes have been developed with a new wire that has three times the strength of any other mesh in the market. Thanks to the strength of the HSD wires, the strength of the HSD mesh itself is also three times stronger, which will in turn produce a longer lasting material holding the registrational accuracy over a longer period.

My gut feeling is that screen printing will be around for a long time. ■

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