



BPS 100

David Rennie

Welcome to another podcast from Air Products. I'm Ed McKendry, and today I'm speaking with David Rennie, US Applications Manager for the BPS product line. David, thanks again for speaking with us.

Thank you, Ed.

I've heard the statement "Clean the Wafer, NOT the probe card!" – tell us what this is about for BPS products. What exactly is the problem statement and what technologies or processes does it apply to?

The BPS product line is a new line of products that Air Products is rolling out into the test, assembly and packaging areas. The statement "Clean the wafer, not the probe card" is associated specifically with the test and probe area of the backend. This is where bond pads, solder bumps, flip chips, etc. are probed and tested for functionality. The current process in the fab or the current main issue in the fab with this process is what's known as "contact resistance" or what we call CRES. Contact resistance is the resistance between the probe tip that comes down to touch on the bond pad or the solder bump and the underlying metal surface that is the bond pad or the solder bump. What happens is that if you have a contamination layer on that metal surface, there's a high resistivity between the probe tip and the underlying metal. Obviously, you want to have as low of a CRES as possible to facilitate better conductivity between the probe tip and the underlying metal surface. Causes of the CRES can vary with anything between fluorine contamination on the metal surface, there could be a metal oxide film, other organic residues could be left on the wafer surface. The issue with CRES is that it could cause false negatives. You could test the part to see if it's functional and because of this contact resistance layer you get a reading back saying that the part is not good, where in fact the part could actually be good, it's just that the probe tip was

be good, it's just that the probe tip was not able to get through that contamination layer to contact the underlying metal surface. So if you have false negatives, you end up throwing away good die so that results in lower yields, you end up going back and reprobng the wafer in order to try to find more good die that failed the first time so that slows down your wafer throughput – so there's a whole host of issues associated with contact resistance. Customers right now use a process to clean the probe tips – because what happens is that after the probe tip touches down on so many of these pads it starts to accumulate some of the contamination from the pads onto the tip. Now, as that contamination accrues on the tip, you start to get higher and higher contact resistance simply from the contamination on the tip. Customers counteract that by, every now and then, cleaning the actual probe tips, which has its own issues, one of which is that it wears away the probe tip which causes you to go through more and more probe cards. These are very expensive instruments and by going through them quicker obviously your costs are higher. Also, you have an extra step in terms of cleaning the probe tip, so every so often when you clean the probe tip, that reduces your wafer throughput because you're spending time cleaning the tips rather than probing the wafers.

Our approach "Clean the wafer, not the probe card" is about cleaning the wafer and cleaning that metal surface prior to the probe tip coming down and testing the part. If we can clean the wafer to remove that contamination and residue before you actually touch the tip down, you will decrease the contact resistance thereby increasing your yield, increasing your wafer throughput, you don't need to clean your probe tips as often – so there's a whole host of good things that happen if you can clean that metal surface prior to doing the test process.

So, in cleaning that wafer, in cleaning that metal surface, do the BPS products affect the underlying substrates or the metal at all?

No, that is one of the attractive benefits of the BPS products. They have very low etch rates on the base metals such as aluminum, copper, your lead tin alloys used for solder bumps. The etch rate on those materials itself is very low, yet the products are very good at removing the metal oxides – aluminum oxide, copper oxide, the lead tin oxides that are on the solder bumps. So they are very selective to the oxide layers themselves. Other competitive products out there either don't remove the oxide layers effectively, or if they do, they have the tendency to have high etch rates on the base metal.

So, what's the process – do you use some special equipment?

The proposed process is very simple – you expose the wafers to one of the BPS products, it's typically used at room temperature – you can heat the product to 35 or 40°C in order to facilitate the cleaning. It's a short process – anywhere from 5 to 30 minutes and you follow the exposure to the BPS product with a short DI water rinse and a dry. In terms of equipment, these products are compatible with all of your standard wet processing equipment – wet benches, batch spray tools, single wafer tools – so the equipment that the fabs already have in place are compatible with these products.

So what are you doing differently from existing methods or materials and what is your competitive advantage – why are you guys different?

We touched on this a little bit already – what customers are currently doing is cleaning the probe tips, and that has a number of issues with it – decreased probe life because you will wear down that probe tip as you clean it more and more frequently. You also slow down your wafer throughput. So what we're doing differently is instead of cleaning that probe tip, we're cleaning the wafer itself. Our advantage is that you will extend your probe card life, which thereby will greatly reduce your costs for the probe cards – again, as I mentioned, these are very expensive – so you want to make those last as long as you can. Also, you do have some benefits downstream and by cleaning off the metal oxide on these surfaces you can eliminate downstream processes such as near the wirebond where some people do a plasma argon in order to clean that metal surface – what

happens is that if you clean that metal oxide with one of our products prior to the test process and probe process – when you get to wirebonding you no longer need that argon plasma because the metal oxide has already been removed.

This sounds like we're saving the customer some money somewhere in this explanation, so talk a little bit about cost of ownership.

The cost of ownership of the BPS products will be less than the current competitor offerings out there. One of the ways that the customers will save money is by extending probe card life, as we mentioned before. Also, they can use cheaper probe cards – there's many manufacturers out there that what they do is to simply try and build a better probe card. And the reason they build a better probe card is that they try to break through this contamination layer to get to lower contact resistance. By cleaning the wafer surface prior to the probe process, you don't need the latest-fangled gadget probe card in order to break through that contamination layer because it's already been removed. Therefore, you can buy cheap probe cards, run of the mill probe cards, and therefore use those instead of the expensive ones. Also, more good die – you will get more good die on a first pass with our product than you will if you don't clean the wafer surface. What I mean by that is the first time you test the wafer, maybe you pick up 80% of the die are good die, and 20% are not good die. If you do a second pass, maybe out of that 20% that originally were bad, some of those were actually good, and you'll recapture those. That decreases wafer throughput and you also run the possibility of not collecting all of the good die. If you clean the wafer surface first, now when you do your test, you capture more good die, especially the first time around, it reduces reprobng, which increases your wafer throughput. All of that goes to the bottom line, which is cost of ownership.

You mentioned earlier, I just want to make sure, that this BPS product line is compatible with typical existing tools and materials of construction – is that true?

Yes that is – we have tested our BPS products with a number of common materials of construction that are used in your typical wet processing equipment. Materials such as 316L electropolished stainless steel, polyethylene, Teflon, PFA – those standard materials that are used in the processing equipment are all compatible with the BPS products.

Talk about your complete product portfolio for pre-probe cleaning and what are the differences between these different offerings?

We have three products that are aimed at the aluminum bond pad probe and test area – those three products are BPS 100/101 and BPS 115 – they're very effective at removing aluminum oxides, so in test and probe applications where you have aluminum bond pad wafers, those are the products that you would want to use in order to clean off that aluminum surface prior to probe. We also have BPS 170 and BPS 172 – these products are very effective at removing copper oxides, and they're also very effective on solder bumps such as your lead tin solder bumps commonly used. They're very good at removing the oxide layers and contamination layers on copper surfaces and your solder bumps. Lastly, we have a product, BPS 125 – which is good for removing organic-type residues, good for removing fluxes and flux residues and other organic-types of residues.

People can get information on these products on a website, I'm sure?

Yes, we do have more information available on our website, www.airproducts.com/bps

You've shared a lot of very good information. If I'm a listener, give me some of the key messages that I can take away from this podcast.

Our BPS product line is aimed at the test, assembly and packaging market. It's a new product line that we are rolling out. In particular, we had some products focused on the test and probe area – test and probe for aluminum bond pads, for solder bumps, flip chips. These products are very good at removing the contamination layers that exist on those metal surfaces which can interfere with the test and probe process, specifically, increasing CRES. Our products will help reduce the CRES which will then cause higher yields, more good die, higher wafer throughput and overall, lower cost of ownership.

Excellent – where do the listeners go one more time – listeners go where for more information on this product line?

Sure, listeners can go to www.airproducts.com/bps - there we have an overview of the product line. We also have narrated presentations on specific BPS products which will go into more detail on the various products. We also have additional podcasts on specific BPS products located there. And as always, listeners can feel free to email me – my email address is RENNIEDB@airproducts.com

Once again for our listeners, you can visit www.airproducts.com/bps for more product information and you can email David Rennie directly at RENNIEDB@airproducts.com. David, thank you again for the information, we appreciate it.

Thank you, Ed.

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