Plasma treatment is an essential step in ensuring the cleanliness of a board to improve wettability and adhesion. Now, the growing complexity of automotive electronics is leading more carmakers to consider using plasma treatment to ensure greater reliability. Nordson MARCH’s Jonathan Doan shares the benefits of the process along with some new information regarding the MES3 requirement with Publisher Barry Matties.

Barry Matties: Please start with an overview of Nordson MARCH, Jonathan.

Jonathan Doan: Nordson MARCH makes plasma equipment primarily for the back end in terms of semiconductor applications and PCB manufacturing, medical applications, some automotive and mil/aero. Really, anything that requires plasma treatment for packaging or fabrication.

Matties: How do you fit into the automotive sector?

Doan: What we’re seeing with the automotive customers is an increase in automation requirements for processing their parts. We’re seeing more of our equipment being used to plasma treat their parts in terms of improving the reliability.

Matties: How does plasma treating improve the reliability?

Doan: What we offer is the ability to thoroughly clean the surface. A lot of times, when you do any type of cleaning of the surface, even if you use a chemical, for example, there’s still some residue. It’s microscopic, but that microscopic layer interferes with adhesion or any type of bond. What plasma treatment does is remove that microscopic layer. You get a very clean, smooth surface that helps with adhesion. At the same time, what we can also do is change the surface energy. That could improve properties previously incompatible to be more cooperative with each other.

That’s really where the plasma treatment, in terms of usage, comes into play. You hear stories about electronics in automobiles failing early, and that’s where we’re seeing a lot of customers, especially as some of the big providers of automotive electronics are seeing more
of their components being used inside cars, with sensors, etc. We’re seeing more of them go to plasma treatment. This is not only from a batch standpoint—where they were using our machines before—but now they’re using an automated machine because they have the new MES3 requirement for automation and tracking to guarantee that if there are any problems from the consumer side later, they can backtrack and figure out exactly which lot and which device went through which process.

**Matties:** *To see who’s liable.*

**Doan:** That’s right. It’s all about liability in the end. That’s one of the things they’re pushing on us right now. One of the big guys out of Europe just recently sent us an MES3 spec saying, “If you can, we want five machines that meet this criteria,” in terms of automation, but also recipe control, lot tracking, and all of that.

**Matties:** *So with the head-in-pillow issue, that’s obviously a big defect. Is this one of the steps someone would utilize to mitigate that?*

**Doan:** Yes, it’s definitely one of the steps you would use to mitigate that, because for head-in-pillow it’s a physical way for them to do the bond. If you have any type of layer in between when you have the physical contact, it will cause poor adhesion. By removing any of that unwanted material, you improve the bond.

**Matties:** *Why wouldn’t someone just do this as a matter of best practice to begin with? Is the machine very costly?*

**Doan:** The machine isn’t very costly, but I think it’s more in terms of looking at it from a longevity aspect. I think we’ve gotten so used to certain products having a certain lifetime and exchange rate that we don’t really build them as reliably. A very good example—although I know it’s outside of the automotive world—is from the old days, when we had VCRs. Originally, everything was hand soldered, everything was treated, and the reliability was very good. Then we went to an automated world where we’re making them very cheaply, but the VCR, instead of lasting

Jonathan Doan, Nordson MARCH.
10 years, was lasting one to two years. It's a disposable thing now.

Now, with cars, the perception in the past was we would swap out a car every four to five years. That's where the mindset came in that we're only going to build a component to handle four or five years. As you see now, people are keeping cars up to 15 years or longer. They need the electronics lasting at least as long.

That's where companies are changing their mindset now. They can't build the way they used to. It's not really a cost factor, it's more of a mentality or shift in how they see where they need to manufacture. You have to look at a car as a commercial good. It's no longer a consumer-grade good; it has to be on the same level as, say, a military-based commercial good that's going to last some time. That's more or less how the end-user perceives it, too. When you're paying a certain amount of money, you want that feel of quality and durability, with minimal time taking it to the shop. That's where the change is coming in. The cost isn't really there. We have automotive customers that, for a long period of time, we didn't see plasma orders from. Suddenly, now we're seeing orders. It's really the shift in their mindset.

Matties: Is it something that the OEMs—the car producers themselves—are requiring in their specs?

Doan: I think so, but I think it's also driven, as you were mentioning earlier, from a legality aspect. You're seeing huge lawsuits, especially with the airbag recall, for example. Even the manufacturer of the airbag doesn't really know the root cause. There's no tracking and such. If you look before that with Toyota and the gas pedal incident, there was not enough tracking to understand exactly where the failure occurred. What they want to do now is also being reinforced from the legal side that says, “If we're going to look at trying to find out the core of the problem, then we need to have better tracking from our component suppliers.” I think the component suppliers are saying, “Okay, if we're making these electronics, we might as well be proactive and prepare ourselves. If it falls on us and we're the ones that have to figure out if we're the cause, it's better if we have all the capabilities and we manufacture for minimal failure.”

Matties: Right, so it's to cover your ass and improve your quality. That's the mentality that we're seeing.

Doan: Yes. It's not just on the automotive segment, either. I think it's most electronics.

Matties: Anything in the high-reliability area where there's catastrophic failure or consequence to catastrophic failure, like ignition switches or airbags, or jets falling out of the sky.

Doan: I think that's the key. Now, all of the various safety boards in the world, as soon as there's any minimal issue, try to mitigate any dangers to the consumer or the person. A good example is Boeing with the battery issue and the minor smoke. They took it out of service completely because they don't want to put people at risk. It's a catastrophic thing that you don't want to have. It goes back to them having to look at the battery manufacturer. How did they build it? What kind of coatings did they use? Those are the types of things that, as a manufacturer, you have to look at how to better control your quality. Sometimes it's really the minute contaminants in between that you're not removing that cause the problems. That's where having some way to microscopically clean materials helps. I'm not against wet. I believe firmly in the use of wet chemicals, because wet chemicals are good for bulk removal. If you have something extremely thick and you need to clean it off, it's great, but it's not going to clean down to the microscopic level. Even the bulk chemical leaves residue. That's the downside.

Matties: Have you done any analysis with and without plasma on A and B products?

Doan: Yes, we have done that. A good example is the packaging of a sensor. Usually, the typical packaging of a sensor is molded on. Using the example of a car, you have stages where the car is parked and it's relatively cool, then suddenly the temperature can easily escalate to
over 120°C. We’ve taken molded sensors and put them through a thermal cycle. What we noticed is, with plasma, after 5,000 thermal cycles, we didn’t see any delamination or any failures within the mold. On the non-treated plasma samples, after 5,000, you already see the edges starting to delaminate. You see weaknesses in those areas. Let’s imagine if you had 10,000 cycles—or even 50,000 cycles, depending upon how often your car goes from low temp to high—those sensors can easily fall apart and fail. If you have a failed sensor, you can have a problem with the car. These are the types of things that we look at.

**Matties:** So you have empirical data that justifies the expense or the process step. **What’s the cycle time in the plasma?**

**Doan:** Cycle time is fairly quick, depending upon what the customer is treating. That’s the good part. If they’re trying to do bulk removal, it may be longer. It can be as much as say, five minutes, or it could be as little as 10–20 seconds.

A lot of the treatments, in the case that you’re talking about, with the head-in-pillow example, it’s a 10-second process for most people to use plasma to treat. You send your part in for 10 seconds, you clear off the oxide and any contaminants, and then the part’s ready to be treated.

**Matties:** Because you have to start with a clean board, have a great stencil, bring in the right amount of paste, and so on. The idea is to eliminate every variable at each step, and that’s what you guys are all about.

**Doan:** Yes, that’s our goal.

**Matties:** Anything that we didn’t talk about that we should be sharing, or that someone should know about plasma?

**Doan:** What we’re doing now, beyond just doing surface cleaning and activation, is we’re also using plasma to coat. This is from a finished product reliability standpoint. Let’s say you have a finished board or a finished circuit. What we can do, instead of just using a traditional conformal coating—which is fairly thick—is use a plasma coating that’s very thin, and then you can package this easily. It offers a nice resistance to humidity and water and such. It’s minimal, it’s not as thick as your traditional conformal coating, but at the same time it offers good enough protection for your package device.

**Matties:** Is this good enough for high-reliability automotive, or is it shelf life?

**Doan:** It’s more for shelf life. In automotive, I think you would still need a thicker coating. With this, it’s thin and it’s not scratch resistant—you can easily scratch it off. This is more to keep the shelf life and protect the circuit from any type of oxidation or any type of degradation. It’s good for when you’re manufacturing large parts and you’re not shipping and packaging them instantly.

**Matties:** Because if we let them sit around, then contamination creeps back in.

**Doan:** That’s right, so that’s what it’s really there for.

**Matties:** Jonathan, it was nice talking to you today.

**Doan:** It was good talking with you.