KLA's Automotive Opportunities

Oreste Donzella, Executive Vice President

September 21, 2021

Atif Malik/Citi: Good morning. Good afternoon, everyone. Welcome to Citi Mega Trends video series. My name is Atif Malik and I cover U.S. semiconductors and semiconductor equipment stocks. The topic of discussion today is autos, and we have KLA with us today. Citi recently published a cross sector report on smart car and expects technology sales to auto industry for EV, ADAS, and other services to exceed those for smartphones, PCs, tablets, and variables combined in the next four to five years. KLA is uniquely positioned with a range of auto products across semiconductor, specialty semiconductor process, and PCB markets within its EPC group and we have Oreste Donzella who runs the EPC group at KLA with us today. Oreste will walk us through a few slides to set up the discussion. If you have questions for KLA on autos, please email them to Amanda Scarnati. That's Amanda.Scarnati@citi.com. And we'll ask those questions towards the end. Please refrain from asking any near term business questions about the September quarter. Management will not be answering those questions. Oreste, welcome. Over to you.

Oreste Donzella/KLA: Atif, thank you very much. I appreciated you hosting the KLA today talking about automotive, as you said, there is a tremendous opportunity for growth in automotive semiconductor, and KLA is uniquely positioned to materialize on this growth. So before I go in the discussion, so the forward looking statements, of course you can see the details in our KLA IR website. Okay. All right. So KLA by numbers. So as you know, these are the numbers we published from last calendar year, is six billions revenue company. It has been present in the semi-conductor equipment spaces since 1976. One thing that differentiates KLA from peers is the amount of money that we spend in RND. We spend 15% of our revenue every year in research and development. This is making our products always on track for what the customers are asking in terms of future requirements.

Oreste Donzella: So as you know, very well, we have been in the semiconductor process control for many, many years. So this is our core business since 1976, is really find the defects that matter and the variation in terms of geometry that affects the chip performance. So we have been in this business for long time. And then recently, we started acquiring companies in particular, the biggest of all was Orbotech including SPTS, that was an independent subsidiary of Orbotech, in 2019. We finalized that acquisition and we integrated Orbotech SPTS and ICOS that was a company that we previously acquired in 2008. We formed the so-called EPC group, electronics packaging and components. You see the structure of the organization with Rick Wallace, the president chief executive officer and three business groups, EPC electronic packaging components, run by me, Ahmad Khan is running semiconductor process control, and Brian Lorig is in charge of the service business.

Oreste Donzella: So this is KLA structure, and of course, automotive goes across the three business groups. So we have solutions coming from each of these group as I will explain later in the presentation. So what we have done also in terms of merge and acquisitions is to increase our footprint in the electronics value chain with EPC and the integration of companies like Orbotech, SPTS and ICOS. We are very much inside the electronics value chain, not only semiconductor process control, but we space now from Wafers, Reticles, chip fabrication, packaging components, print circuit boards, and display. So, we are serving a multitude of segments around the electronics supply chain. And we are also working with the end market. We work with the automotive industry and with the mobile industry to make sure that whatever we produce in terms of tools or software solutions are relevant for the end markets that we ultimately serve.

Oreste Donzella: As Atif said, automotive is going to offer an incredible opportunity to the entire electronics supply chain and in particular to suppliers for automotive semiconductors, because we see the long term growth of automotive semiconductor outgrowing the rest of the end market, like mobile or data center and so on. So the automotive will get to the fastest growth. Let me talk a little bit about the evolution of the industry here, trying to explain what's happening in automotive. And there are many, many different points I like to make. First of all, starting for what automotive has become in the last few years and what will become in the next five or 10 years. And it's all about leveraging data and the connectivity. So when we talk about the new automotive industry now automatically we think about electrification. We think about how we connect everything inside the car, or eventually in the future, how we can drive the car by itself with autonomous drive.

Oreste Donzella: Of course, in order to enable these revolution in the automotive industry, you need a lot of semiconductors. You need a lot of new electronics. And if you look at each of these trends, you see like a pretty broad portion of the semi-conductor that is enabling this trend. So connectivity, for example, requires higher RF/Modem content. In electrification, we see more and more the adoption of compound semiconductor materials like Silicon carbide and gallium nitrite. In autonomous drive, of course we will see the shift of the automotive industry to more advanced technology. And overall we see also more adoption of memory chips inside cars. So a broad range of semiconductor devices are now in modern vehicles. So not only the content of semiconductor is much higher in the new vehicles in the future cars, but also the range of the semiconductor devices is very, very broad creating a lot of, of course, risks, but also opportunity for the entire industry.

Oreste Donzella: So what happened during the pandemic? So automotive industry went down a little bit in particular in terms of semiconductor demand, even before the 2020 COVID and 2019 was a low year for automotive semiconductor. When we were expecting that the rise would come in 2020, of course, everything stopped because of the pandemic and people didn't order semiconductor for automotive anymore. But eventually what happens after a few quarters, a couple of quarters, we see a huge rise of demand of cars and vehicles. And in that case, we saw a huge rise of demand for automotive semiconductors and inventory were depleted. And in this case, because more and more people are adopting cars, electrical cars, as some other more modern cars, the content and the range of the semiconductor devices was such that inventory was not able to supply all the data that industry needs.

Oreste Donzella: So for that kind of reason, we saw a big shortage in chips. And eventually the trends are now accelerating after the pandemic. So we see more people switching to electrification. They are still very interested in autonomous drive and ADAS, and of course, networking and connecting car and safety and security are still paramount. So we are seeing now the automotive industry in particular, relative to the semiconductor portion of the supply chain accelerating trends after the pandemic. And because of that, of course, we saw, as I said before, a big dependency of the overall automotive industry semiconductor. So you saw some of the news in the past six months, chip shortages expected to cost out the industry 110 billions in revenue this year. And when you look at how pervasive now is semiconductor supply chain in the automotive industry, you understand why we are having all this challenge, but this is overall an opportunity as well.

Oreste Donzella: So now let me go through the biggest challenge of all. One day, the supply and the demand will rebalance in automotive, but we will still have the reliability and quality as a priority. Number one, in automotive, the zero defect is paramount. So because of the liability, because of the cost of recalls, you need to have extremely reliable semiconductor devices inside the car. And, and now on top of the fact that reliability has always been the number one factor for semiconducter inside the cars, we also have new trends, again, pushing more reliability, like the autonomous and the connectivity, in the car. As I said, we have the trend of shifting to more advanced semiconductor devices that generally are not going through the same qualification and maturity time of the trailing edge nodes. For that kind of reason, quality and reliability are becoming even more challenged in cars because of the proliferation of more advanced technology nodes inside the vehicles.

Oreste Donzella: So part per billion quality requirement is now in automotive industry. And of course, this is by far the most stringent requirement in terms of semiconductor quality and reliability of all industries. So when you look at quality/reliability challenges, what the automotive industry has been doing for a long time, is a set up a multitude of tests that are going above and beyond what the other industries are doing. Like for example, burn-in, stress test, a more reliability test that are trying to catch these chips that are eventually marginal because whatever operating conditions. Chips that are marginal at test and then get installed on a board in a car, eventually failed when you drive your vehicle and the liability is gigantic in case one of these chip fails while you are driving your car. So for that kind of reasons, automotive has always been doing this very, very stressful test.

Oreste Donzella: However, they are not sufficient and still we see test escapes or the so-called the latent reliability defects. So what are they? So test escapes are defects that eventually escape the test, all the electrical functionality, reliability and burning tests because of some coverage gap or because sometimes the test is not 100% accurate. The latent reliability defects are even trickier. So the latent reliability defects are the defects that can pass all the functional tests, all the reliability tests and burning stress tests and so on, but they are marginal under certain harsh environmental conditions, in terms of temperature or humidity and so on, they fail in the car and this is

Oreste Donzella: ... the enemy number one of the automotive industry right now. So how can you prevent either the test escapes or the latent reliability defects happening? And this is where KLA has been focused in the last three, four years. Not only building and shipping process control and process tools for the automotive semiconductor industry, but also find some new methodologies how you can create some band aid, some techniques that can minimize or even prevent the occurrence of these latent reliability defects and test escapes. And this is what the I-PAT is all about. I-PAT means Inline Parts Average Testing, and this is the new inline screening standard at the fab level the KLA has been developing for the last three, four years, and now is a released product since June, 2021. I will explain a little bit how I-PAT is now complementing whatever the automotive industry has been adopting for decades in terms of testing.

Oreste Donzella: So when you look at overall test of a semiconductor device, you have a process control on the left side, electrical test on the right side. Process control, of course, this is what KLA invented 25 years ago with inline monitoring concept on the KLA brightfield tool that now we call broadband plasma imaging tool. And this is really when in the mid '90s, KLA came with their idea of, "Hey. We can help our customers to increase the yield by adopting a very rigorous methodology in controlling defectivity and all the geometry in X, Y, Z direction through our metrology tools. And then we establish multiple process steps in the integration flow of the semiconductor devices with fabs where we believe these were the most critical process steps to be monitored. However, even if the process control is very important to identify yield killers and minimize the excursions, not all wafers are measured. For that kind of reason, the process control idea cannot be implemented as sorting, because really you're not sorting every single wafer every single time.

Oreste Donzella: On another hand, electrical tests are done on 100% die. But as I said, we still have escape, either because the test coverage is not 100% or because we have occurrence of latent reliability defects that are good under test condition, but they can fail in the car later because of environmental stressful conditions. So that's the reason why these two methodology are existing. They are good. They complement each other. But they are not perfect. So what we are proposing with the I-PAT, it's an inline defect screening that you implement a 100% inspection on some particular process steps, not all of them, because otherwise it's very expensive for wafer fabs, and you implement with an optimized inspection tool, in general, we use the 8xxx series with machine learning methodology that drives you to which wafer you need to inspect giving really the weighting factor of any defect that this tool is capable for detecting and say, "Okay. Based on all my machine learning methods and model, I know that defect A at the step X is the most critical one in terms of potential reliability failures after test."

Oreste Donzella: And this is what I-PAT is all about. Of course, it's very simple to say that, but we have been working for three years on this particular methodology, because first of all, you need a lot of data to make sure that you teach your neural network model. Second, you need to go through many, many iterations of your machine learning technique to make sure that you are giving the information to your customer they need to screen inline for potential reliability failures later.

Oreste Donzella: And just to give you a visual example, without inline screening, without I-PAT, you haVE a process control inline on the left side of this page and you see you can stop excursion lot, but eventually because you don't inspect every single day, every single week and every single step, you have bad chips are passing because they don't get inspected. And then electrical test, you see generally you can stop most of the failures, but some can escape. What I-PAT does is really putting a new filter here. So it's inline screening to make sure that you have fewer escapes after all the functional parametric, electrical, reliability and burn in tests.

Oreste Donzella: As I said, it's a machine learning methodology. So we have all the inspection and metrology attributes from every single inspection that is done inline at the wafer fab level. We have all the data coming from the tests, all the examples of potential reliability failures that our customers are willing to share with us to build this model. Of course, this methodology can only be implemented if there is a very, very strong, close and credible collaboration between us and our customers, because it's based on data. And of course, there is a protection of data. We are very, very sensitive to protect that information from our customer. Also, the customers protect information that we generate with our machine learning model. So we create this correlational engine. We give weighting to every single defect at every step. We do our aggregation. And finally, we come up with a metric that is giving the inspection an idea of the most critical defect for potential reliability failure at this step with this particular process.

Oreste Donzella: So we integrate I-PAT, it's an integrated solution. This is a combination of a tool that is in general the 8xxx series, our inline screening inspection tool. And then of course, there is a lot of gathering of information. So this is what we call I-PAT. This is really giving the deeper DNA and extracts every single potential attribute from these wafer to generate data that eventually will feed into the SPOT product that is our neural network model based on machine learning. And eventually, with a Klarity defect database and analytical system, we have the final output to our customer telling them what is more critical than anything.

Oreste Donzella: This is just an example. And I presented SPIE in the February many examples of how I-PAT works in real world. This is just an example of collaboration we have done with one of our customers. So we started with, again, getting the data from our 8xxx tool. We got data from wafer sort to packaging, unit probe, final test, burn-in and post-burn-in test. And then we ran all our machine learning model. And then we figured it out by doing correlation that there were few defects that completely escaped the functional test, but the I-PAT was able to find inline.

Oreste Donzella: So if you don't have the I-PAT in that particular process step implementing the fab, you are going to really let these die pass, all the final tests and either if they fail at the burn-in, it will create a lot of additional costs. You don't want to do burn- in tests on wafer of dies that are already screened out. Or even worse, they pass every single electrical test until they get in the car. And we found few of these defects, of course, on a population of 100,000 defects that we analyze in our machine learning model, that escape everything, and they went directly in the automotive supply chain. And think about the value of this information. Think about the value of an automotive semiconductor customer or even more the value to the tier one or the automakers in identifying the chips, that are on a board in your car. Eventually I-PAT was able to screen out and avoid these very expensive recalls and huge liability if the car fails.

Oreste Donzella: And this is the value of I-PAT. And this is what we have been working for, as I said, three, four years. I'm very proud that I drove this particular project inside KLA and we got a lot of other momentum behind it. In fact, we got so much momentum that now, if you look at the Automotive Electronics Council guideline for Zero Defect Framework that is really the quality and reliability standard for automotive semiconductor, now you see the Parts Average Testing and the I-PAT concept written in the specs for automotive semiconductor. Okay. So this is the I-PAT that is pretty much the real innovation in terms of how to generate data-relevant solutions to minimize reliability failure in cars. But now let me talk a little bit about products. So we introduced four products on top of I-PAT that I've already presented. We introduced products last June, 2021. C205 is our customized broadband plasma imaging tool for automotive market. Then we have 8935 that is the latest and the greatest 8xxx series for inline screening. Of course, the broadband plasma imaging tends to be used mostly for advanced technology, for R&D and ramp phase in the automotive semiconductor, while 8935 is the work horse for inline screening. And also Surfscan that is our unpatterned wafer inspection monitoring tool. We came out with two new configurations called SP A2 and SP A3 customized for automotive.

Oreste Donzella: And everything is going to be connected to I-PAT. And right now I-PAT is connected with 8935, then we will create connection of other tools in case we need it. And again, when I say customized for automotive means that we also develop some unique software and algorithm features on these tools to make sure that we have better classification to reduce over-kill, to improve the under-kill detection and also traceability of the die inside the wafers.

Oreste Donzella: Now let me switch a little bit. So I talk about process control, but after the Orbotech and SPTS acquisition, as Atif said, we also have a division inside EPC that produces not inspection metrology products but process products, in particular PVD, CVD and Etch, so deposition and etching products. And SPTS has been the market leader for Power semiconductor for long, long time. And of course until a couple of years ago, Silicon Power was the only Power semiconductor going to automotive, but now in the last few years, we see more and more adoption of compound semiconductor, in particular silicon carbide, but we see gallium nitride, for example, being adopted for off-board charger and some other applications not automotive based, mostly relative to RF infrastructure. But silicon carbide is becoming very, very popular and

Oreste Donzella: fastest growing type of compound semiconductor to be used in the automotive space for electrical vehicles. And you can see here, the biggest value for the compound semiconductor, like silicon carbide is that they can operate at much higher temperature and they are very, very efficient in terms of power consumption. So they really help with the biggest problem for the electrification of the vehicles, that is power efficiency. And we are developing now in SPTS, a new process solutions, mostly Etching to enable this transition from silicon to silicon carbide power at our customer's sites. So, you can see on the right side of silicon carbide, our revenue trend that we expect in 2021 in SPTS going up substantially in this year, because of this rise in adoption of silicon carbide.

Oreste Donzella: So just a quick look back to 2019, September, 2019, we were in New York City before COVID. And I was there with Rick Bran, Brian Ahmad. All the executive staff went to New York to explain the narrative behind the Orbotech and SPTS acquisition. At that time, we started introducing our story about automotive, that we were real uniquely positioned versus the other suppliers because of the work that we were doing in terms of methodology for screening and reliability, and at that time we said, this was our plan, really to go through the automotive electronic industry.

Oreste Donzella: In the early 2010, we started providing process control systems, but we were no real presence in the automotive ecosystem. In 2018, when we had an opportunity that eventually materialized with IPAT, we started developing internal capability there. We started outreaching industry doing workshop, building awareness of what we were doing. 2019 was a pivotal time for us because we anchor the automotive electronics council, we are the only equipment supplier for semiconductor participating as a member of this association that define the standards for the automotive semiconductor, and then of course the rise in 2020, 2021 and beyond.

Oreste Donzella: So we are now capitalizing on the secular trends in the automotive industry, and we leverage the breadth of our KLA portfolio and the innovative solutions like the IPAT that I was explaining. So we outline a certain revenue plan. I'm not going to disclose numbers today, but we are ahead of the revenue plan that we outlined in the investor day 2019. And so we are very, very happy to see that our revenues increasing substantially in the automotive market or in the semiconductor products that we sell for automotive market.

Oreste Donzella: In summary. Reliability and new materials are really critically. If I want to point out two things that KLA is really uniquely positioned in the automotive industry is first of all, our process control screening methodology.

Oreste Donzella: The second, is what we are doing at SPTS enabling the silicon carbide with the etching and deposition solutions. The combination of the two put us in incredibly good position, very unique position to enable the new automotive industry. And this is just a summary slide. You see identification of the challenge, find a standard developing screening solution or process solution for electrical vehicles in terms of new compounded material like silicon carbide, and eventually launch a product portfolio, customized for the automotive industry. And we will keep working on new product launches in the next few years as a combination of hardware and software, and that's my last slide. And I really appreciate the opportunity to talk to you all.

Atif Malik: Thank you Oreste for that comprehensive overview. You talked about the shortages we're seeing, you talked about the value proposition for KLA in auto and in the background on the products. And as a reminder for the audience, if you have questions for Oreste, please email them to Amanda@scarnati.com. And we'll ask those towards them.

Atif Malik: Oreste, for us generalists, how are quality and reliability requirements different for auto chips versus the broader semiconductors, and how do the failure rate requirements compare?

Oreste Donzella: Yeah, as I said in the presentation, automotive industry has always, always been the most stringent industry in terms of reliability and quality of semiconductor devices. For that kind of reason, they are requirements as part per billion which is pretty much zero defect. That's what zero defect is all about is really getting the parts per billion failures eventually going down to zero, if we can ever reach these zero number. So it's way more stringent than any other industries like mobile or like IT-related, or even data centers. Although there are opportunities in some of the industries to scale up as well. I mean, we see that data centers, for example, they have to be up 100 percent of the time. So maybe we will see some of these reliability and quality requirements going from automotive also to other industries, like for example, servers and data centers.

Oreste Donzella: However, going back to automotive, it definitely has the most stringent requirements in terms of reliability and quality. And as I said, regardless, what we have been doing for many, many years still, we face escapes. We face huge costs in reliability recall and also potential liability issues for the car makers. That's what this what IPAT is all about as I explained. So we are trying to define methodologies to screen potential reliability failures in fab, instead of waiting the chip to fail in the car. Eventually, yes, you got it right. This is the most stringent industry by far in terms of reliability and quality requirements.

Atif Malik: Great. And Oreste, in 2019, KLA defined new screening methodology to minimize failures in automotive semiconductor technologies. You presented an interesting keynote SPIE in February this year on iPad. And you talked about it in line defect, hot average testing for zero defects. How's the adoption of these new screening methods going? I think in your keynote, you talked about case studies you're doing at some customers. So talk about how has the adoption of these new methods that are going and the impact you're seeing on your products like ServeScan, it series...

Oreste Donzella: As I said, we have in the work for three, four years. There's been a long journey because again, you need a lot of data. And in order to have this data, you need to make sure that you collaborate with the customers to transfer the data back and forth, with all the protection that is needed for exchanging this information.

Oreste Donzella: So that's the reason why it took a while to get this methodology. And then when we refined the model, that again is a machine learning AI type, we started the first validation. First proof of concept validation was done last year. In fact, I presented a bunch of use cases in SPIE and after the SPIE that happened in February, we started beta for customer sites. They are customers with automotive semiconductor devices that span from Foundry's 40 nanometer to analog parts and much larger design rules .

Oreste Donzella: We are doing the beta right now. Then we introduced the product already in June, as I said. We are very confident because we have done a proof of concept for four years, and we are also receiving initial orders. And again, iPAT is a combination of software solution algorithm solution, but also implemented initially on 8XXX series. And in fact, we are also seeing a significant increase in the revenue, this tool, this year, driven by the automotive industry. So people buy the 8935 as I introduced that earlier because of the capability of the tool, for sure, for this particular application, but also because it's tied to iPAT, because these two solutions talk to each other and they are very, very sticky. They work very well together and people are more motivated to buy our tool also because of the iPAT software algorithms solution we implement.

Atif Malik: Great. How does the transition to new materials like Silicon carbide, gallium nitride for power semiconductors in [inaudible] impact your auto sales?

Oreste Donzella: As I said, of course, silicon carbide and gallium nitride, I call exotic materials because they are materials that have not been proven yet. We are working with silicon for 50 plus years. So we know Silicon very, very well. Silicon carbide is brand new material. First of all, it has a different type of defectivity failures, and also is different to etch, it's very hard material to etch, for example, and we need to develop a new process control solution but also process solution. So I give the example that SPTS with our etch solution, has revenue rising quite a bit to this year. And these tools require some modification of our tools or we make completely new chambers. Because one thing is that etching silicon and one thing is etching Silicon carbide.

Oreste Donzella: Deposition is a little bit more similar between these materials, but the etching is very, very different. For that kind of reasons we were very early on with SPTS to work with our customers to provide the solutions for etching Silicon carbide, and now we are pretty much receiving results in terms of revenue. So it's a long journey, there will be some time before Silicon carbide will become industry standard for automotive power, a few years at the least, and remember, silicon carbide is now done in six inch and eventually the industry will move to 8-inch while Silicon power is 12 inches, so it's more efficient from a wafer size point of view, but I believe we'll get there. And what we have seen so far is a very good adoption of our SPTS solutions and the adoption can only increase in the future.

Atif Malik: Great. For us, [inaudible] is uniquely positioned among front end equipment names in terms of auto exposure. You've talked about five to 10% of your sales this year and growing 40 to 50% annually and understand this is a bit of an unusual year where things are rebounding because of supply shortages, but looking

Atif Malik: After the strong dollar content growth in this end market, how should we think about the long-term growth of your auto sales?

Oreste Donzella: It's absolutely positive. I'm very optimistic. Of course, 2021 has been a particular year. Everybody knows of the chip shortage and the huge rush to order everything that is required to go back and produce cars. No question about it. And by the way, the supply chain is still disrupted. I don't believe that the supply demand imbalance finish anytime soon for automotive. So it will take a few more quarters to have this in balance, this supply- demand. But overall, the prospect is good for two reasons.

Oreste Donzella: First of all, because there is going to be more content of semiconductor in cars. And the second reason is because of the complexity of the challenges that the automakers and their supply chain are facing right now as I told about the silicon carbide or the requirements in terms of reliability getting more and more stringent or the adoption of the advanced semiconductor in cars. Everything is painting a very optimistic picture for KLA to capitalize of this growth. So I'm extremely optimistic on the next few, several years actually, of the demand of automotive semiconductor and overall the revenue of KLA in this space.

Atif Malik: Great. Next I will, we'll go to audience questions. Amanda, do we have any questions?

Amanda Scarnati...: Yes. I have a couple of questions here. The first ones are kind of continuing along the silicon carbide discussion. Can you talk a little bit about the Plasma Etch market for Silicon carbide devices and how, what KLA has is different than what competitors have?

Oreste Donzella: Yeah. First of all, we are using a different chamber for silicon carbide that have been developed along the years to make sure that we have the right profile, either on the trench or planar. Silicon carbide process can be done either in planar, or in trench. So we have a machine that is capable for getting the best uniformity of the etching process, either if you adopt a Silicon carbide planar, or a Silicon carbide trench type of process stacks. So it's really in all of the experience that we have accumulated along the year. First of all, being the leader in the power Silicon and then implementing all the learning in silicon power and adopting pretty much the new models, the new chambers for silicon carbide etching.

Oreste Donzella: So again we were early on, on Silicon carbide etching. We are capitalizing on this learning that we have done two, three years ago working with our customers. And they continue to progress. For example in the etching, as I said, that there are two ways to etch silicon carbide. Either a planar structure or a trench structure. People will move more and more to the trench structure, and the trench structure will have even more challenges to support the required profile of the trench. The bottom of the trench has to be rounded, has to be straight. So SPTS is like a Swiss army knife company in the etching solution because it's been living the entire life customizing process applications, tailoring to customer needs. So we do a lot of customization and yes, this works in our favor whenever an industry or a new process like silicon carbide starts its ramp.

Amanda Scarnati...: The next question is, you mentioned briefly silicon carbide versus GaN and your sides. Can you compare and contrast maybe the opportunity and the materials, technology, for those two devices in terms of usage, advantages, cost, comparison, differences in processes and manufacturing processes?

Oreste Donzella: Yeah, that's a great question. So first of all, I believe that they will be used for different applications. So if you look at silicon carbide, I believe will replace silicon for a power inverter in the automotive. I don't see gallium nitride to be used for it. Gallium nitride is used either on silicon or on Silicon carbide itself that is an interesting combination for RF infrastructure, for the 5G infrastructure, for RF devices in the 5G base stations. We see more and more gallium nitride used for high power lines. That is more like an industrial type of application. So these two, for sure, these two materials will progress in the years, but they will be complementary. I don't see them like replacing each other. I believe this space is so big in the power semiconductor, and eventually in the RF communication, that there will be space for adoption, increase of adoption of both silicon carbide and gallium nitride.

Oreste Donzella: And of course they have different type of challenges. Both the materials have not been in the market for the same long time the Silicon has been, for example. They are hard material. They are hard material to manage. There are problematical defects. For example, we have some type of defects that we see on epitaxy, that we have not seen in silicon before. It creates a lot of challenges, a lot of the potential on both process control and process. But again, big adoption for both materials, for different applications.

Amanda Scarnati...: Switching gears a little bit back to the new products that you announced in the June quarter. Can you talk about how much software plays a bigger role in, in these products? You've talked about machine learning. Can you quantify the value maybe of software versus the actual physical products?

Oreste Donzella: Well, we sell the product. We don't quantify. We don't sell piece of product. They say, "Oh, this is a 20% is software, 30% is algorithm, 50% is optics, etc. we the product itself." Software is becoming more critical, paramount.

Oreste Donzella: I'll give you a good example. I talked a lot about iPAT that is machine learning methodology. We develop a lot of AI type of algorithms with our data scientists, at KLA. But AI has been in KLA for a long time. So people look at AI and say, "Oh, this artificial intelligence. People are using more AI." KLA started adopting AI, classifying defects with our broadband plasma imaging tool, and now even detecting defects in our most advanced inspection, across the entire inspection portfolio, including ebeam, our new beam inspection system that we released several months ago. We have been using this AI for a long time to classify defects, and now even detect defects.

Oreste Donzella: We also use AI to simulate the structure that we would like to measure for profile, for a long time, for a decade. Now we use AI for defining a new methodology to screen potential reliability failures in automotive market. So the artificial intelligence and machine learning neural network models are becoming absolutely essential to make progress in the process control field for semiconductor right now. And now we are doing a lot of work in packaging as well. Inside EPC, of course, we have a few new packaging products. Even in packaging, we are adopting now some of the AI, artificial intelligence experience in front-end. And we are putting these AI machine learning algorithms to be smarter and classify defects, either in wafer level packaging level, but also assembly and tests. So software is absolutely essential. It's becoming more and more essential. I can quantify 30, 70%. It's an integral part of the solution.

Amanda Scarnati...: Great. Those are all the investor questions I have right now. Atif, I'll pass it back to you.

Atif Malik: Thank you, Amanda. Oreste, thank you for so much for your time. We're around the 15 minute mark. Audience, if you have any questions on KLA auto products, please reach out to IR team to Ed and Kevin. Oreste, thank you for your time.

Oreste Donzella: Thanks for the opportunity. Thank you.