



A roadmap of continuous innovation: View from SEMICON West by Linde Electronics

By [Rob Cockerill](#) | 27 July 2017

Rewind 3 to 4 years, and much of the conjecture in the electronics business surrounded the next wave of expected technologies and wafer fabrication processes, from 450mm wafers to 14 nanometer (14nm) node transistors to lithographic patterning.

This created a collective feeling of uncertainty at the transition to these new technologies and a fear of being either the early adopter – and potentially the bearer of many pitfalls that this might bring – or slow on the uptake and quick to lose ground in this fast-paced business.

Coming out SEMICON West 2017, however, is a newfound vibe of clarity and confidence. That's according to the Head of Market Development at Linde Electronics, Dr. Paul Stockman. The industry is in a moment of relative certainty, he says, with less confusion about 'the next big thing' and more conviction in the technological roadmap. It's a roadmap of continuous innovation: less doubt, more confidence.

The footprint of the event in San Francisco (US) earlier this month was down, **gasworld** understands, but the footfall or traffic was broadly the same, with the event moving toward a more targeted, focused mode of interaction.

The message coming out this gathering was also more focused, with seemingly less upheaval and apprehension in the marketplace – from the major OEMs right through to materials suppliers such as Linde. Dr. Stockman explains, "I think what we see now, from an industry point of view, is that it's less about discrete innovation, with questions such as, what is the next node? With the advent of 3D structures and with the complexity at the

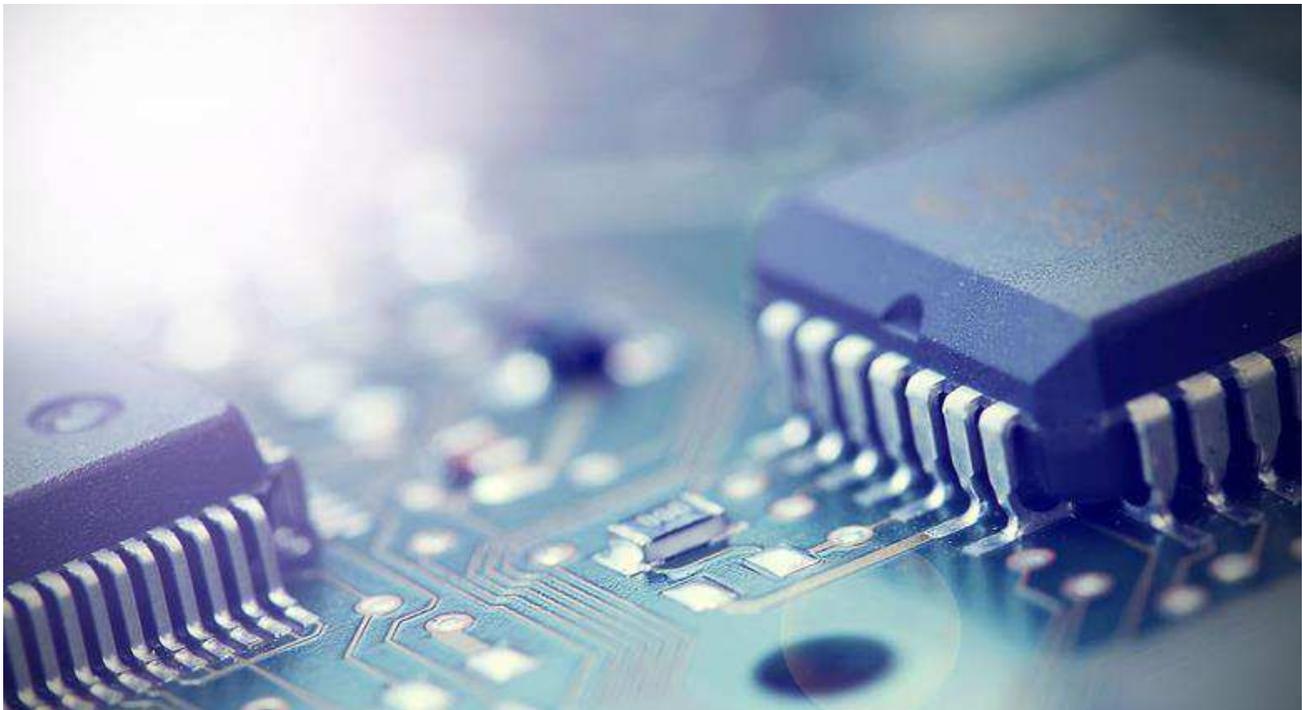
leading-edge of logic and foundry, I think what we see is that the industry is proceeding at more of a continuous innovation.”

“It’s not about the next big thing, but about all of the continuous innovation.”

For electronics materials suppliers like Linde, this translates to increasing demand for consistency and quality in bulk, specialty and rare gases delivery. “For us, this is relevant in terms of the technology with these 3D structures; it’s much more about deposition and etch from a specialty gas perspective,” Dr. Stockman says.

“One of the messages we had going into the show was about rare gases. These are becoming increasingly important in semiconductor manufacturing, all the way from the traditional laser gases that have been used for the past 30 years, as well as new applications in laser anneal for both semiconductor and for display, to etch assistance for some of the 3D structure processing.”

“For Linde, we have the largest portfolio of our own sources of rare gases being made in our air separation units, as well as a portfolio from third party sources. This is definitely a message that we put out before the show and we continued to follow up with both in terms of defining who are and how we invest in customers, as well as for specific customer interactions.”





Key trends

Dr. Stockman notes that the continued rise of China as an electronics hub was one of the key takeaways from the show, while on the technology front the fruition of the Internet of Things (IoT) has created a lot of stability and optimism in the industry – even for legacy 200mm wafer fabs.

China moving to forefront of electronics sector

“In terms of the industry overall, I think it was very positive. Right now we’re in the midst of one of the strongest cycles in recent years in terms of dollar value, but also important for a materials supplier like Linde in terms of the number of chips, the complexity of those chips, and the amount of silicon area that’s under manufacture.”

“A theme that we saw mature this year was the whole buzz around IoT. A few years back there was quite a lot of hype around how many billions or even hundreds of billions of things there were that were going to be connected. A few years on from that initial wave of hype and I think we have actually seen the reality develop underneath that. For us and for our customers it’s quite encouraging, it becomes much more concrete about how things are going to work.”

He elaborates, “What we see are at least two distinct markets that are going to come out of this. On the Things side, all of the smart devices, this was the hype part [of recent years] and this is becoming much more concrete; these things are getting manufactured, we see it in our own everyday lives with the number of things you are connecting to, and how your home or business network is increasing at a very fast pace.”

“These things need to be quite small, quite cheap, and what it means for our customer portfolio is that the capacity to manufacture at older technology nodes in logic and foundry are being very well supported by these. In fact, there’s even an uptick in 200mm [wafer] manufacturing.”

This is an interesting point where both the industry and the gases it requires are concerned; 300mm wafers came in at the beginning of the 21st century and within a decade or less, most manufacturing in terms of silicon area was at the 300mm level. Legacy 200mm fabs were therefore in danger of becoming a thing of the past, but the realisation of IoT is breathing new life into these trusted sites. “There’s a huge number of 200mm fabs out there that are 15, 20 or more years old – and they have found a new lease of life with this IoT application wave,” affirms Dr. Stockman. “And these Things are extending not only to devices in our houses but to businesses, cities and even smart vehicles. All of this is loading up these legacy fabs.”

“At the same time, the cloud is getting very well supported and accelerating this growth. Most of these things aren’t so smart themselves, but they’re sending data and having it processed and then returned to them over high-speed networks and the data is being stored and processed in cloud computing centres. So this is driving not only the expansion of the types of server logic and memory chips that are required for the cloud, but it’s also pushing the innovation on those chips to make them faster and safer.”

“If you follow the loading of 200mm fabs, it was never like they were on some sort of death spiral, but they have levelled off. Now there’s an uptick in the loading and, in fact, SEMI was reporting that market for used 200mm equipment is actually becoming quite active and main equipment manufacturers are actually building quite a bit of new 200mm equipment just to meet the demand.”

All of which is challenging companies like Linde to improve the quality and consistency of materials that they’re delivering to customers.

“It’s not about waiting for the next process node, it’s about the continuous improvements that are being made. You see it with 3D NAND – now that the main manufacturers have all shifted their focus to 3D, the improvements are being made in how many layers they can efficiently make and how they can package these to get the highest amount of value, and this is something they can do very quickly and on their own without re-tooling. It means that they are making advancements very quickly and continuously.”

“By adding layers like this it pushes us as materials suppliers because they’re having to push the processes further and it comes back to us in terms of improving our product offering as well.”

“This is, again, primarily in deposition and etch products. For 3D NAND, these are generally built up by depositing alternating layers of sacrificial layers and insulators, and then etching them. These are very high aspect ratios that are now extending down through over a hundred layers of material, and then re-depositing materials in the etched out spaces to form the conductors and the memory storage devices.”



Clarity

Though this will not reduce the current portfolio and demand for specialty gasmaterials, another trend to emerge from SEMICON West was the increased certainty in extreme ultraviolet lithography (EUV) on the technology roadmaps of the major manufacturers for new leading-edge fabs.

On the future technology roadmap for some time now, but a source of much hesitation in recent years, the confidence in EUV is another trend helping to bring about clarity and assurance in the business.

“Overall, the observation would be that things are very positive,” Dr. Stockman concludes. “We’re in the midst of a cycle that economically is quite positive, and the strongest we’ve had in recent years, and from a technology point of view I think that things are quite clear for our customers in a way that they haven’t been for quite a while. Not to say that people were stymied, but things have become much more settled in terms of the technology roadmap.”