阅读中文新闻简报

ElectronicsIQ.

Information Quarterly from Linde Electronics.

THE LINDE GROUP

Linde

Summer 2013

Welcome to ElectronicsIQ, the quarterly update from Linde Electronics.

The age of materials

In this article, Chris Edwards, editor of electronics for Engineering & Technology, discusses the evolution of Moore's Law and how the age of materials in high-integration electronics awaits.

Read more…

Nanotubes: innovation for next generation displays

Many high value electronic devices, including the latest touchscreen smartphones and tablets, are built using transparent conductive thin films. Currently the electronics industry relies primarily on one material – Indium Tin Oxide (ITO) – to manufacture TCFs. Linde Electronics' nanomaterials division is developing an alternative: single-walled carbon nanotube (SWNT) technology for integration into electronic devices as a TCF.

Read more…

Lithography in the spotlight

Lithography has been in the spotlight recently because it helps the industry keep up with the pace of Moore's Law. It is an enabling technology and one of the first steps in semiconductor manufacturing, before the deposition process and without lithography, it would be impossible to create semiconductor wafers. This article looks at how enabling the production of chips with layer geometries of less than 10 nM, EUV lithography will drive innovations in the consumer electronics devices of tomorrow.

Read more…

My life at Linde

We speak to Anish, Head of Global Semiconductors Market Development at Linde Electronics. Anish talks about who and what inspires him; the fast-moving world of electronics; and the career path he took to his current role.

Read more…

Partnership with Voltaix to drive memory chip innovation

As mobile devices become equipped with more and more functionality and higher performance, the industry is seeing increasing demand for larger NAND and DRAM memory capacity. To support this growth, Linde has made a significant investment in a new ultra-high purity disilane plant in Upper Mt. Bethel Township, Pennsylvania, owned by Voltaix, a leading manufacturer of materials for the semiconductor and photovoltaic industries.

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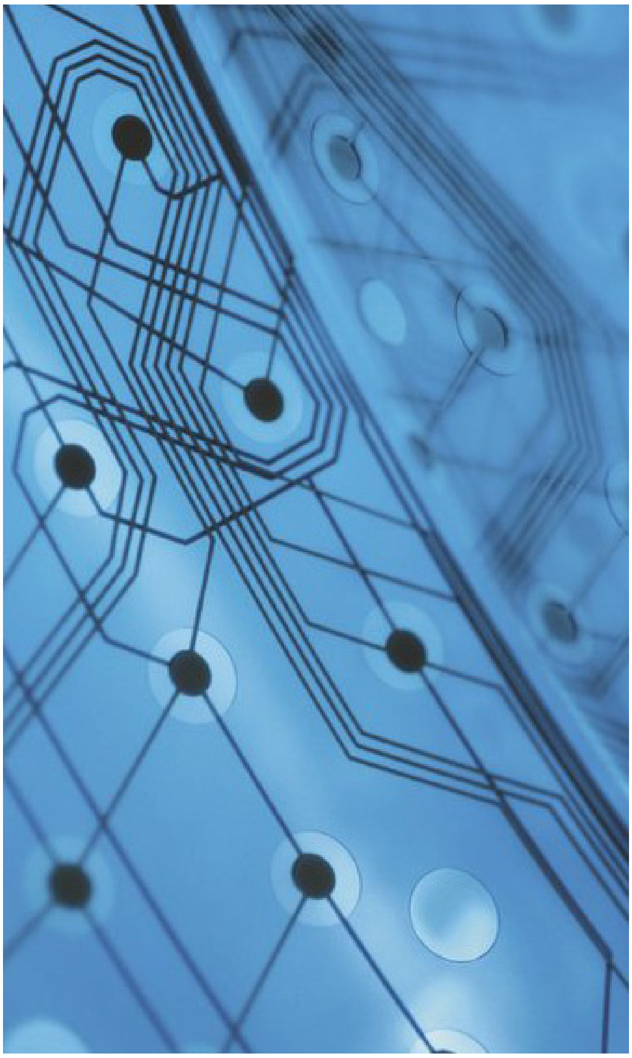
Viewpoint by Chris Edwards, electronics editor, Engineering & Technology, published by the Institution of Engineering and Technology

The age of materials

Less than ten years after pioneer of circuit design Professor Carver Mead coined the term "Moore's Law" people started to think this process, which describes the way in which integrated circuit (IC) density doubles every couple of years, would quickly run out of steam.



It was a false alarm. Chipmakers smashed through the limit of 1µm that some thought unsurpassable. Today, close to 50 years since Gordon Moore first identified the phenomenon, the scaling law that carries his name is still progressing along much the same lines. But, because we can begin to see the end of conventional 2D scaling things are changing.

In the 1970s, Moore identified three key components to what drove the improvements in density: increases in die size; improvements in circuit design; and the scaling of the features themselves.

For a long time, silicon and a few select materials were able to support this last component incredibly successfully, which was fortunate as the first two quickly ran out of steam. Through a process called Dennard scaling, named after IBM researcher Robert Dennard, not only did circuits get denser as they reduced in size, they got faster and less power hungry.

Things began to change about a decade ago. Process engineers realised that scaling on its own was failing to deliver the speed and power savings to which customers had become accustomed. Technologies such as strained silicon appeared, using other elements such as germanium, to distort the crystal lattice to help electrons move more freely.

Materials science is now coming to the fore much more strongly. Inside the transistor, silicon may give way entirely to elements such as germanium, gallium and arsenic, all of which provide greater electron mobility. They may even be replaced by carbon in the form of graphene and nanotubes, both of which will call for innovations in the way that these materials can be deposited on a wafer.

Although it has delivered density, Moore's Law scaling has taken its toll on the tiny wires that connect transistors. As their width has reduced, resistance has steadily climbed. One change came ten years ago in the form of copper. The next step may be to introduce another low-resistance metal, to form copper-gold filaments.

Memory, which dominates most computer designs, provides the richest field for material innovation. Devices based on novel alloys could form the basis of memory cells that retain their contents when power is removed but with the immediacy of conventional silicon devices. But the biggest shift could come with the memristor, which can use many different types of material system. It is a device that combines logic operations with memory, opening the door not just to new ways of computing but making it easier to scale no longer in two dimensions but in three. The age of materials in high-integration electronics awaits.

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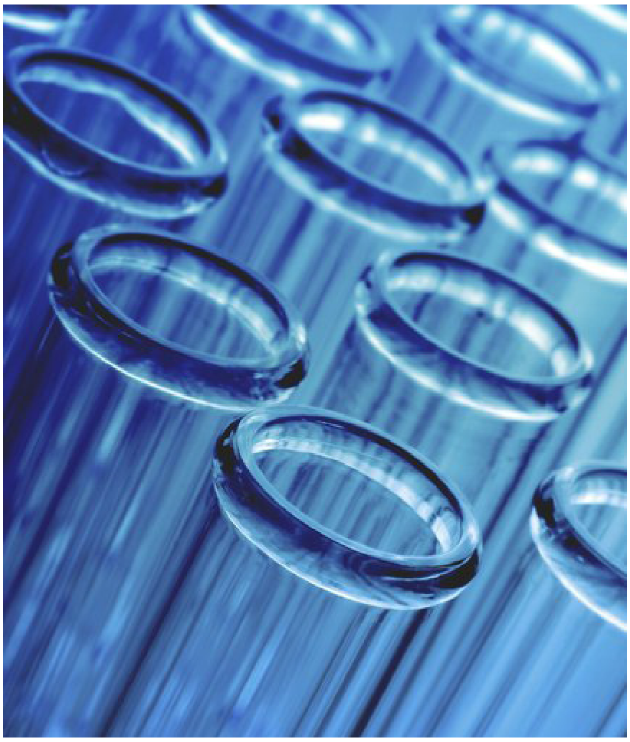
Nanomaterials – innovation for next generation displays



Many high value electronic devices, including the latest touchscreen smartphones and tablets, are built using transparent conductive thin films. Currently the electronics industry relies primarily on one material – Indium Tin Oxide (ITO) – to manufacture TCFs. Yet, there is a need to find an alternative to ITO because it is a brittle material, making it unsuitable for touchscreens and flexible displays. ITO also reflects a significant amount of light, causing a loss in luminance for backlit displays and touch panels, and increasing the power required to provide a given luminance. Finally, the cost of processing ITO is very high.

To overcome these challenges, Linde Electronics' nanomaterials division is developing a single-walled carbon nanotube (SWNT) technology for integration into electronic devices as a TCF.

SWNTs are one of the most exciting chemical discoveries of recent times, offering an opportunity for entirely new technologies to be developed. To illustrate, they could enable the manufacture of smartphones with a screen that rolls up like a window shade, or see-through GPS devices embedded in the windshield of a car.

From a technical point of view, SWNTs are an allotrope of carbon, like graphite and diamond, and they have unique physical and electronic properties. These properties range from a higher thermal conductivity than diamond and greater mechanical strength than steel (orders of magnitude by weight), to a larger electrical conductivity than copper. It is due to these and other unique properties that carbon nanotubes are likely to be of great importance in future displays.

Using the proprietary SEERTM processing technology, Linde Nanomaterials is able to produce SWNT inks that enable the deposition of SWNT TCFs with 'best in class' performance. Thanks to Linde's extensive process knowledge, the SEERTM carbon nanotube inks exceed the most stringent purity and reproducibility requirements, meeting the demands of the world's largest display and semiconductor manufacturers. It is therefore only a matter of time when we will see completely new display technologies being manufactured, using Linde's pioneering SWNTs.

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Lithography in the spotlight

Since the summer of 2012, the three biggest players in the semiconductor industry have all made considerable investments in ASML, a Dutch company that develops complex lithography machines that play a critical role in the production of integrated circuits or chips. Furthermore, in October 2012, ASML announced that it would acquire Cymer, a supplier of lithography light sources. The driver for these deals is to accelerate the development of key lithography technologies, notably Extreme Ultra Violet (EUV). EUV lithography will help the semiconductor industry to build chips at the 10-nm node, facilitating the development of smarter, more powerful and more energy-efficient devices for consumers.

Lithography has been in the spotlight recently because it helps the industry keep up with the pace of Moore's Law. It is an enabling technology and one of the first steps in semiconductor manufacturing, before the deposition process. Furthermore, without lithography, it would be impossible to create semiconductor wafers.

Photolithography is the patterning process that transfers the design of a process step from a mask to a light-sensitive material – or photoresist – coating the wafer surface. UV light passes through the transparent parts of a mask and softens the positive photoresist. The softened photoresist is dissolved with a developer solution, whereas the unexposed areas remain hard and on the wafer surface. The image of the positive photoresist is the same as the image on the mask. In complex integrated circuits, a wafer has up to 50 layers exposed to photolithography; the objective is to enable many millions of shapes to be printed on the wafer.

Excimer based lithography uses an excimer (short for 'excited dimer') laser for its light source, which requires a range of specialty gases, including argon, krypton and fluorine. Utilising an electric charge applied to the gas in a chamber, an excited dimer is formed in the laser. When the charge is eliminated, the dimer tears apart, giving off laser light. This process can be repeated up to 8,000 times per second in the latest generation lasers.

With new 300 mm fabs costing in excess of $4.5 billion to build, the cost of down time can run as high as $800,000/hour. It is therefore easy to understand the critical importance of using the best laser gases available in the world. Linde has been supplying the world's lithography industry for over 20 years with its SPECTRA gases, which have been used since the development of the earliest lasers for lithography.

Linde's SPECTRA lithography remains on the forefront of supporting the continued extension of DUV technology too. This long term commitment to the market has allowed Linde to build strategic, long term relationships with the companies involved in the development of EUV lithography. Linde actively supports these companies in their development efforts, and looks forward to the new opportunities the EUV technology will provide Linde.

Current semiconductor industry roadmaps predict that laser based lithography will be in use for at least 20 more years. Yet, in order for Moore's Law to continue for the years to come, we must see a fundamental shift in lithography – DUV lithography must be replaced by extreme EUV lithography for critical layers of 10nM or smaller. As tablets, smartphones and laptops get smaller, sleeker and more powerful, EUV lithography will help overcome today's semiconductor manufacturing challenges. By enabling the production of chips with layer geometries of less than 10 nM, EUV lithography will drive innovations in the consumer electronics devices of tomorrow.

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My Life at Linde,

Anish, Head of Global Semiconductors Market Development, at Linde Electronics

What motivates you to get out of bed in the morning?
I'm always fascinated by the new and exciting developments in the fast-moving world of electronics.

Describe your colleagues in three words
Smart, motivated, collaborative.

Tell us a little about your background - university, degree, qualification etc.
I have a PhD in Chemical Engineering from Purdue University. Prior to joining Linde, I had fifteen years of experience in the various sectors of the electronics industry, including semiconductors, display and solar industries. I've been in roles ranging from R&D to process engineering, product management, marketing and consulting.

How long have you been a part of the Linde team?
I joined Linde in November 2007 as part of the market development team.

What does your role entail?
My job is to help define the growth opportunities for Linde's electronics business. Sometimes that involves investigating new, exciting and emerging sectors such as solar and LED. Other times it is about keeping abreast of technology and business trends and their impact on Linde Electronics. It also involves working closely with our R&D and commercialisation teams to define new product offerings.

Is there anyone within the organisation who inspires you and why?
It's hard to point out a single individual. There are so many bright, motivated people in the organisation who I learn from every day!

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Partnership with Voltaix to drive memory chip innovation

As mobile devices become equipped with more and more functionality and higher performance, we're seeing increasing demand for larger NAND and DRAM memory capacity.

This trend is reflected in the improving outlook for the memory chip industry: the analyst firm IHS believes that the NAND flash market will benefit from the trend towards greater mobility, as consumer devices such as smartphones, tablets, and Ultrabooks, which are enabled by NAND flash memory, become increasingly popular. IHS estimates that after a year of setbacks in 2012 due to oversupply and weak global demand, the NAND flash market is expected to rebound in 2013, reaching revenues of $23.7 billion, and achieving growth of 7.2% through 2016.

To support this growth, Linde has made a significant investment in a new ultra-high purity disilane plant in Upper Mt. Bethel Township, Pennsylvania, USA, owned by Voltaix, a leading manufacturer of materials for the semiconductor and photovoltaic industries.

The production of advanced memory chips involves ever-smaller critical dimensions, which leads to challenges in the deposition of ultra-thin amorphous or polycrystalline silicon films. Disilane (Si2H6) is one of the new materials being adopted by the industry to ensure good continuity and smoothness in these films. Linde has partnered with Voltaix to facilitate the production of next-generation NAND flash memory chips through the provision of disilane.

The investment in disilane and the Voltaix facility, which has an annual capacity of 40 tons, reinforces Linde's position as a leading specialty gas supplier for the electronics industry. The partnership will enable Voltaix to ramp production of advanced memory chips in line with growing demand from mobile equipment manufacturers.

Linde LienHwa recognised by TSMC for excellent performance in gas materials

Linde LienHwa, the Linde Group's joint venture with the LienHwa MiTAC Group of Taiwan, has been recognised by TSMC for excellence in gas materials performance at the semiconductor manufacturer's 12th annual Supply Chain Management Forum.

The theme of the forum, held in December 2012, was "Innovate and Win Together". Over 450 suppliers around the world in the fields of equipment, materials, packaging, testing, facilities, IT systems and services, export/import services, and environmental and waste management participated in the forum.

TSMC's Supplier Excellence Awards, announced at the forum, recognise eight outstanding equipment and materials suppliers, such as Linde LienHwa.

"TSMC's mission is to be the trusted technology and capacity provider of the global logic IC industry for years to come, and our supplier partners play a key role in helping us fulfil this mission," said TSMC Chairman Dr. Morris Chang. "We believe that by joining with our supplier partners to find innovative new modes of collaboration, we will reap even greater rewards together as we continue to drive Moore's Law forward."

For more information please visit: http://www.tsmc.com/tsmcdotcom/PRListingNewsAction.do?action=detail&language=E&newsid=7481

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Linde Electronics receives Intel's Preferred Quality Supplier award

Linde Electronics and Specialty Gases, a division of Linde North America has been recognized as one of 17 companies receiving Intel Corporation's Preferred Quality Supplier (PQS) award for their performance in 2012. Linde's electronic gases business is recognized for its significant contributions providing Intel with ultra-high purity gases, equipment and on - site services deemed essential to Intel's success.

Cliff Caldwell, vice – president and general manager for Linde Electronics, said, "We are proud and honored to have received the PQS award for the third time. Intel is a valued customer of Linde North America and The Linde Group and our people are committed to meeting the requirements of the semiconductor industry. Intel continuously challenges us to enhance our world-class supply chain with evolving benchmarks for performance, quality, execution and business continuity. We are dedicated to innovation and delivering products and services in support of Intel's current and next generation technologies globally."

"Our sincere congratulations to Linde Electronics for their accomplishments this year and winning the 2012 Preferred Quality Supplier award. The Linde team has demonstrated consistent excellent performance in quality, availability and technology. Linde continuously provides outstanding support of our gas and chemical supply chains. We greatly value and appreciate this partnership," said Tim Hendry, Vice President, Fab Materials Operation, Intel Corporation.

The PQS award is part of Intel's Supplier Continuous Quality Improvement (SCQI) program that encourages suppliers to strive for excellence and continuous improvement. To qualify for PQS status, suppliers must score 80 percent on a report card that assesses performance and ability to meet cost, quality, availability, technology, environmental, social and governance goals. Suppliers must also achieve 80 percent or greater on a challenging improvement plan and demonstrate solid quality and business systems. Additional information about the SCQI program is available at http://intel.com/go/quality.

A celebration to honor PQS award winners was held in San Jose. In addition, there was an announcement on Intel's website at http://intel.com.

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