

Electronic Gases in 2015

By Rob Cockerill

Specialty gas consumption has grown significantly in recent times and continues to build momentum in many countries, led by the strong and established North American market, where the largest demand is seen, and buoyed by a fast-growing specialty gases business in the Asia-Pacific region.

Previous forecasts have suggested the global specialty gas market will reach a value of \$23 billion by 2018, based upon an average annual growth rate of 6.1 percent for the period 2013-2018. What effect — if any — the plummeting price of oil in 2014/15 will have on this projection is not yet known, though many of the key end-user sectors for specialty gases (electronics, healthcare, for example) are not likely to be affected.

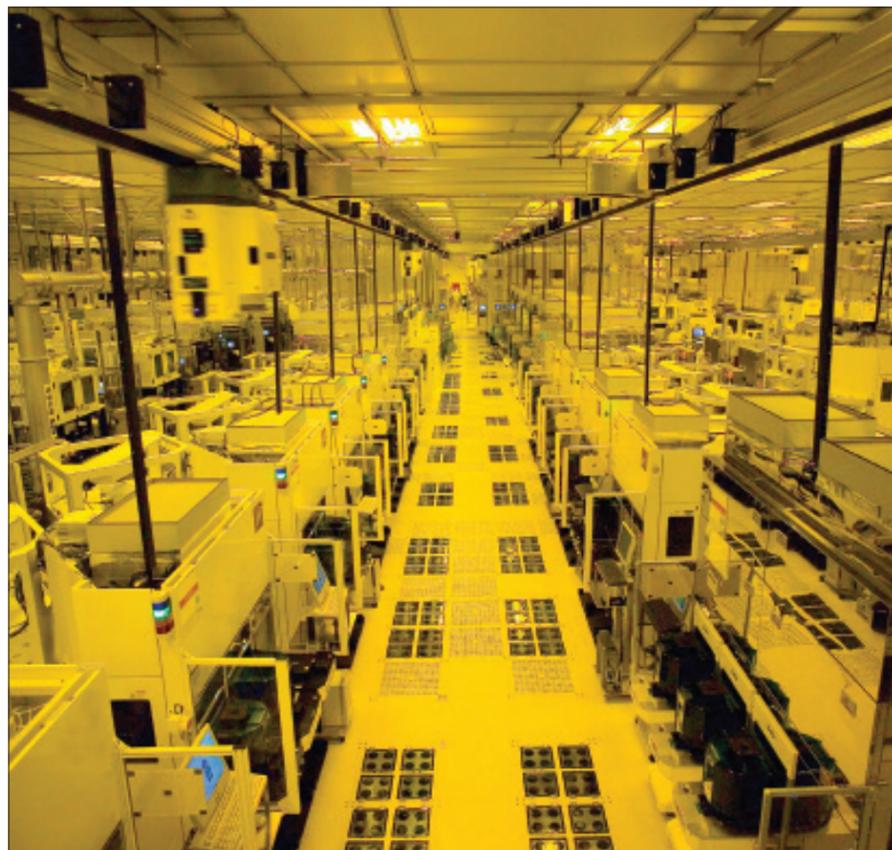
Moderate specialty gas growth in the US is expected to continue, driven by demand for smart devices that require an increasing number of ever more complex and smaller semiconductors. For more detail on this topic see, “Shrinking Devices, Growing Demand: Meeting the Electronics Challenge,” on page 30 of this issue.

See Related Articles on specialty gases in emissions and environmental monitoring in the fourth quarter Specialty Gas Report, which accompanies this issue of CryoGas International.

New market growth

Specialty gas suppliers continue to focus on capturing the expanding energy and emissions market, according to Ohio-based investment bank and M&A experts League Park.

Legislation relating to shipping emissions and environmental monitoring controls in a number of Asian countries is a factor in 2014/15, ensuring busy times for suppliers of specialty gases used in environmental monitoring and control applications. When it comes to measuring exhaust emissions, vehicle manufacturers turn to calibration gases to check the measurement



processes and to calibrate instruments for the measurement of exhaust emissions.

Electronics

According to Ohio-based investment bank and M&A experts League Park, a traditional and core growth driver for the specialty gases business is the electronics sector. This is also an application in growth mode in 2015.

League Park Director Wayne Twardokus explains, “The electronics marketplace continues to experience solid volume potential — smart devices, gesture control, and improvements in automotive electronics systems are expected to drive 3-5 percent market growth.”

“In addition, the consumable nature and continued improvements of consumer electronic devices is maintaining a rela-

“...the consumable nature and continued improvements of consumer electronic devices is maintaining a short product lifecycle, which supports demand.”

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Trends in the electronics business include a growing shift toward adding more value to microchips, known as More-than-Moore (MtM), the gradual transition to the next step in lithography, extreme ultraviolet lithography (EUVL), and the increasing implementation of “greener” chamber cleaning solutions.

Developing MtM technologies to add value to semiconductor chips is now an important focus, involving not just shrinking devices down, but using new materials to add levels of functionality not necessarily linked to Moore’s Law. Many of these new elements will require new gases and precursors to match, resulting in the use of many more elements than the usual array of silicon, hydrogen, carbon and nitrogen, such as Si-Ge, hafnium dioxide (HfO₂) metal gates, and zirconium dioxide (ZrO₂) capacitors. Higher purity deuterium gas and boron trichloride (BF₃) are also understood to be coming into use. Many of these will be liquids and some will be solids — creating new challenges in vaporization and delivery systems.

When EUVL comes into play, this is likely to consume large amounts of hydrogen. It is thought that EUVL will be fundamental not only to a single-exposure path of production that keeps costs in check, but also makes the economics favorable for the introduction of 450mm wafers. A continued reliance on advanced

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lithography applications until then will see sustained consumption of carbon dioxide and laser gases, including laser mixtures using krypton or argon and fluorine. In fact, *CryoGas International* understands there will be an increased consumption of deposition and etch gases as a result of the double and multiple patterning used to circumvent wavelength issues caused by delays to EUVL.

The means of lithography is unlikely to change the role of cleaning gases used to clean deposits off the process chamber walls, with chamber cleaning mostly

achieved via nitrogen trifluoride (NF₃). There is a trend toward using fluorine (F₂), however, as it delivers better cleaning performance while having zero global warming potential. Due to its advantageous chemical properties, F₂ reduces cost for electronics manufacturers, lessens their environmental impact, and creates major process efficiencies not available with NF₃. While it may not be as simple as replacing one gas with another, the benefits that can be gained are significant. By implementing F₂ on the tools studied at a typical 300mm memory customer, Linde noted last year, tool availability improved by three weeks per year and there was a reduction in the mass of gas consumed by more than 2.5 tonnes, along with significant reductions in both power consumption and CO₂ equivalent emissions when the whole lifecycle of NF₃ is considered. ■

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