MATERIALS AND PROCESS CHALLENGES BEYOND MOORE

Alan Brightman explores how precursor materials and reaction by-products lead to the ***simultaneous*** challenges of corrosion and condensation management in a vacuum system.

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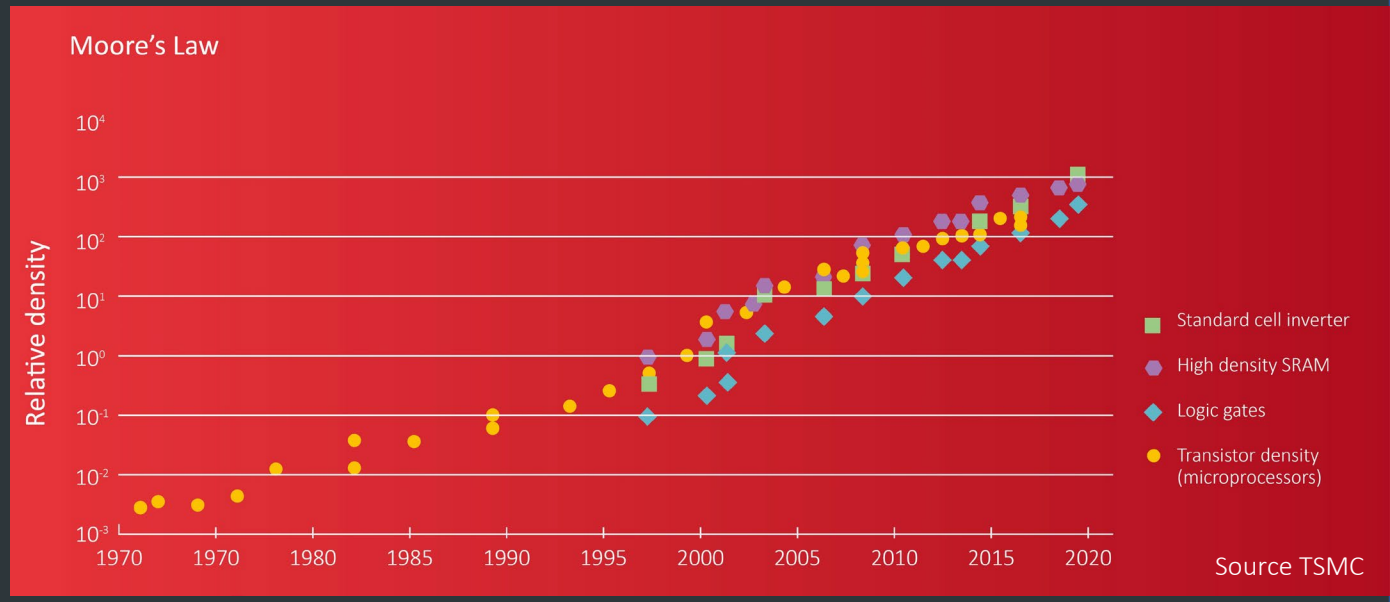
Design for cost-effective solutions to meet the simultaneous challenges of corrosive and condensable precursor materials and reaction by-products in a vacuum environment.

Moore’s law is maintained by developing cost effective capital equipment solutions. This development must consider aspects such as energy efficiency, an expanding range of materials and hazard risks.

(n.) Moore's Law is the observation made in 1965 by Gordon Moore, co-founder of Intel, that the number of transistors per square inch on integrated circuits had doubled every year since the integrated circuit was invented. Moore predicted that this trend would continue for the foreseeable future. In subsequent years, the pace slowed down a bit, but data density has doubled approximately every 18 months, and this is the current definition of Moore's Law, which Moore himself has blessed. Most experts, including Moore himself, expect Moore's Law to hold true until 2020-2025.



ENERGY EFFICIENCY – PART OF THE EQUATION

The cost of energy can be 5 to 30 percent of fab operating expenses, depending on local electricity rates.

Wafer processing tools account for 30-40% of the total energy consumed. To maintain critical process parameters and avoid costly downtime, much of the wafer processing support equipment is oversized and operates above the actual, required specification.

Minimising energy consumption becomes even more critical during times of reduced production, which periodically occur during the semiconductor industry business cycles. In order to maintain fab operating conditions, power consumption remains fairly stable, placing additional cost pressure on reduced semiconductor device manufacturing volume.

Furthermore, green initiatives, oftentimes government mandated, provide additional motivation to adopt solutions of greater efficiency.

At the same time, the technical requirements for semiconductor manufacturing are becoming more challenging.

THE EXPANDING RANGE OF MATERIALS

For example, the range of CVD process precursor materials and associated reaction by-products, vulnerable to condensation in chamber vacuum dry pump systems, is expanding. In this regard, challenging substances include ammonium chlorides, ammonium fluorides, hafnium chlorides, sulphur-based compounds, liquid precursors, and others.

TWO CONCEPTS IN CONFLICT

To some extent, the tendency for materials to condense in most vacuum systems can be reduced by diluting the exhaust with inert gas, as is done to control flammability. If, however, dilution rates are reduced to lower cost and improve abatement efficiency, an alternative strategy is needed to control the condensation of liquids and solids in the process exhaust stream.

HAZARD RISK

Clearly, the major perceived risk associated with condensation is blockage of the chamber vacuum system and a consequent process interruption, caused by excessive dry pump exhaust pressure or breach of seal integrity, due to high pipe internal pressure.

However, there are also other serious hazards that may result from condensed materials in the vacuum system. To counter the condensation threat and improve system safety and productivity, the capability to run the vacuum system at optimized and uniformly controlled temperatures is critical to the success of the manufacturing process.

To ensure no condensation occurs, a clear understanding of the CVD precursors and associated by-product material condensation points is essential. Therefore, addition, health and safety risks to operating and service personnel can be greatly reduced.

More frequently, CVD precursors and associated by-products introduce corrosion challenges, along with the aforementioned need to manage condensation. Developing solutions to manage these competing needs is becoming ever more more challenging, particularly when operating cost is also of concern.

In order to meet fab cost of ownership requirements, as well as government mandated energy reduction targets, significant innovation is required to develop robust solutions that withstand harsh manufacturing conditions.

In my white paper presentation I explore the various techniques employed to effectively manage condensable and corrosive by-products while simultaneously reducing power consumption and resulting operating costs.

CONCLUSION

Significant innovation is required to develop robust solutions that withstand harsh manufacturing conditions.

Contact Alan Brightman directly to discuss the subject.

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