



UNDERSTANDING INTEGRATED VACUUM CHALLENGES FOR EUV LITHOGRAPHY

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Introduction

2021 will be remembered for many things.

Certainly, among them in our industry will be the growing acceptance of extreme ultraviolet (EUV) lithography in high volume manufacturing (HVM) at the most advanced nodes.

EUV lithography allows manufacturers to continue the reduction of feature and device sizes that has defined progress in semiconductor manufacturing from its earliest days.

However, the investment required to use EUV in HVM puts tremendous pressure on manufacturers to maximize output to achieve an acceptable return.

The overall throughput of the system is essentially fixed, so efforts to ensure ROI must focus on maximizing system availability minimizing operating costs.

Maximizing availability

Maximizing availability EUV lithography is the beating heart of next generation semiconductor manufacturing processes. Just as all blood flows through the heart, every layer in an IC begins with lithography.

The lithography system must run all the time, and if it stops, so does everything else. Lithography throughput effectively gates production capacity, but the cost of additional capacity is very high, making lithography system availability the key to success.



Maximizing availability

From our point of view in the sub-fab, maximizing availability requires, at a minimum, that all vacuum system maintenance is performed in the shadow of EUV system maintenance.

This becomes increasingly challenging as EUV systems mature and their maintenance windows shrink. Ensuring that sub-fab systems do not impact EUV availability through unplanned down events starts with designed-in reliability and redundancy — pumps must not fail unpredictably. And if one does, the vacuum system and the EUV system it supports must be able to continue operating.



How is Edwards ensuring safety?

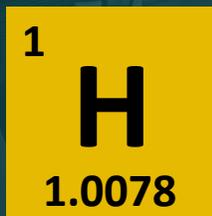
The art of innovation lies in finding ways to ensure the safety of fab personnel, the surrounding community, and the environment, while also enhancing efficiency and reducing operating costs. EUV uses a significant amount of hydrogen which creates a high focus on safety and environmental due to its flammable nature in air.

Edwards EUV systems use vacuum pumps designed specifically for EUV process, incorporated traps to capture reacted compounds. Entire system includes safety sensors to ensure no flammable mixture is present through the system.

Traditionally use of fuel fired abatement systems have been used to burn the hydrogen downstream of the vacuum pumps, however this method requires significant energy and resources and requires ongoing maintenance.

How is Edwards ensuring safety?

Fortunately, hydrogen itself has no negative environmental impact. Once its concentration is below the minimum flammability level, it is quite safe. Fuel-free hydrogen management relies on a keen understanding of flammability levels, dilution technologies and industry safety standards. The critical operation is the dilution of hydrogen with air, a counterintuitive approach.



However, by keeping the critical path, where the mixture is flammable, very short and carefully monitored, the gas is quickly diluted to non-flammable concentrations that can be safely conveyed through the fab and released directly into the atmosphere.

Fuel-free hydrogen management eliminates the fuel cost and carbon emissions of controlled burning and the high cost of nitrogen for dilution.

Edwards position in the EUV market is unique

Edwards position in the EUV market is unique. We have been involved in the technology's development and deployment for over 20 years. We have shipped more than 140 systems over the last 11 years and have more than 70 integrated systems currently installed, providing both vacuum and abatement for EUV processes.

20

Years

140

Systems

70

Integrated
Systems

In 2017 we opened an advanced manufacturing facility for EUV vacuum systems in Cheonan, South Korea. We have strategically located service technology centres close to EUV customers around the world, from which we can dispatch experienced service personnel and provide advanced technical support.

We are intimately familiar with the industry's EUV technology roadmap and have longstanding working relationships with EUV system providers. One lesson that we have drawn from this long and deep experience with EUV lithography is that success requires much more than the ability to pump a lot of hydrogen.



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