

## Views

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# Interview: What's next in lithography?

<https://doi.org/10.1515/aot-2017-0070>

**In September 2017 AOT Editor in Chief Michael Pfeffer visited Dr. Michael Liehr in Rochester, N.Y., to talk with him about recent progress in EUV lithography. Dr. Liehr is not only CEO of the new American Institute for Manufacturing for Integrated Photonics (AIM), but also Executive Vice President for Innovation and Technology and Vice President for Research at SUNY Polytechnic Institute (SUNY Poly) in Albany.**

AOT: What do you see as the key achievements solved for EUV lithography already?

Liehr: It took time, but now we can say that the migration from UV refractive systems to reflective soft X-ray technology is on its way to mass production. This is everything but simple. The source power had to be brought up, and resist photo speed and outgassing problems had to be overcome.

Initial challenges with mask shadowing effects and defect levels have also been sufficiently addressed. And while each of those technical developments has progressed, the technology uptime has reached the level of



The ASML TWINSKAN NXE:3300B EUV lithography tool at the SUNY Polytechnic Institute cleanroom in Albany, NY.

80 percent; with ASML working aggressively to a next goal of 90 percent.

AOT: What is left to be done, and how far are we from high volume manufacturing (HVM)?

Liehr: Source power and reliability remain key issues. ASML has demonstrated 210 W EUV source power in their labs, but there is still some way to go until 250 W is available in mass production. This power level enables scanner throughput of 125 wafers per hour. The overall machine speed depends mainly – but not only – on the EUV source.

Other challenges continue for EUV resist performance. Although EUV lithography processes in vacuum, it is still approaching its natural limitation in physics. Meeting the requirements of resolution, line-edge-roughness, and sensitivity is still something to work on.

The same holds for the continued decrease in mask defects, including establishing a pellicle option.

The main question is how long it will take until the current systems are ready for high-volume manufacturing. I can't tell you, but I expect more information from ASML in their November conference.

AOT: What comes next in lithography?

Liehr: That's hard to say. Next advances will definitely include an increase in numerical aperture for EUV. Maybe multi-pass EUV? Advanced e-beam on-wafer lithography? We already see interesting multi-column e-beam approaches for mask processing.

Imprint technologies have made remarkable progress recently, but can they overcome the challenges of material science when approaching molecular-scale resolution and alignment?

## About AIM Photonics

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leadership in a technology that is both essential to national security and positioned to provide a compelling return-on-investment to the US economy. For more information about AIM Photonics, visit <http://www.aimphotonics.com/>

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Publisher

Advanced Optical Technologies



Dr. Michael Liehr, Vice President for Research and CEO, AIM Photonics, holds the world's first 7 nm node test chip; produced using several EUV-printed layers in the SUNY Polytechnic Institute cleanroom in Albany, NY.