Understanding EUV Lithography Basics and Status

Key Concepts

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For a better understanding of EUVL's status, challenges and opportunities, it is important to study its fundamental components. There are several, with the main ones being source, mask, optics, imaging and resists. They are very different from those in the current 193 nm immersion lithography, and a comprehensive overview of these components is a must. Hence, in the annual EUVL Workshop we dedicate one full day to a study of fundamentals with experts. Here I will tell you briefly about them.

EUVL is basically an optical projection lithography, but with many twists. The main reason for this is the 14x decrease of wavelength to gain on resolution, while previous reductions have been much smaller, like 1.5x. This steep decrease in wavelength requires us to work in a new region of physical properties of materials, in greater depth than we have done before.

The EUV light source is the most complex part of EUVL, and it took the most effort and time to develop. This technical feat is truly doing "rocket science" in the fab. This source was a potential showstopper at one time and now it is the key enabler for EUV for today, and for future extensions. Times have changed! For scanners, we use tin based laser produced plasma sources, but for metrology many other types of EUV sources are used and few others being considered. We will discuss technology, challenges and potential of these sources and their metrology.

Inside the EUVL scanner we use mirrors instead of the lenses used in 193 nm scanners. EUV optics, once considered impossible to manufacture, today is ahead of the curve in needed performance. But there is always more work to be done to get ready for the next nodes. EUV optics and optics chain design in an EUV scanner add unique properties to EUVL patterning. Just like optics, EUV mask is also made of multilayer mirrors with several additional levels of complexity – off-axis illumination and 3-D effects to name two. We are also learning to deal with mask defects, cleaning, defect detection and now pellicles.

Patterning with EUV involves dealing with 3-D effects, flare, new illumination and unique EUV specific optics designs. It now works like a charm, but lots of effort has gone into it to. Today, a lot more work currently is being done to extend patterning to smaller nodes with higher numerical aperture (NA) scanners. EUV resists with more energetic photons have a different chemistry and patterning performance. This is making us look

beyond traditional chemically amplified (CAR) resists into new chemistries and do additional fundamental research.

Another important question for many small and large, new and established suppliers for various components for chip-making, especially who arrived late to the game, is where their products, supply chains and competencies fit in the EUVL food chain. Getting to know the fundamentals and overview of EUVL status and challenges will make the picture clearer for all. As all components interact with each other, people working in one area of EUVL with benefit immensely with an overview of other areas as well. We hope that a day of going over the EUVL basics will be very worthwhile for those who climb the hill of Berkeley this year to attend the EUVL Workshop. Additional information about this EUVL short course is available at www.euvlitho.com