Trends in microlithography

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Over the last 30 years the minimum feature size of leading edge integrated circuits has been reduced by 30% every three years. This reduction of minimum feature size has fueled a booming semiconductor industry since it resulted in a price reduction while simultaneously increasing performance and decreasing power dissipation.

To pattern these features optical reduction projection lithography remains the workhorse of the semiconductor industry to this very day. This has been possible due to a combination of:

?? wavelength reduction (g-line ? i-line ? 248 nm ? 193 nm ? 157 nm),

?? increase of numerical aperture of the projection lens (0.4 ? 0.9), and,

?? various imaging enhancement techniques like phase shift masks, quadrupole illumination, improved resists, *etc.*

In the presentation I will argue that despite ever-increasing engineering challenges it is expected that optical lithography can be used in mass production at least until the 70 nm node.

It is expected that classical optical lithography will run out of steam around the 50 nm node, which will be used in production of commercial IC's around 2007 if the current two-year cycle of the industry is extrapolated into the future. Various alternatives exist for optical lithography, including: x-ray proximity lithography, extreme ultra-violet litho, e-beam direct write, e-beam projection litho, and ion beam projection lithography.

Despite all the progress made on these so-called "next generation lithographies" all of these alternatives to classical optical lithography need significant technological improvements. In the presentation a summary will be given for the main challenges that need to be overcome.

Finally it will be pointed out that technical feasibility, although essential, is not sufficient for a successful introduction of a new technology. Economic viability, both in term of initial investments to build a new infrastructure as well as the cost of ownership to use a new technology is of utmost importance. In the presentation, economic viability will be discussed in qualitative as well as quantitative terms.