Measurement Solutions Delivered to Industry for Optical Nanolithography

Supporting/Contributing Agencies: NIST

NIST has made essential measurement advances in optical nanolithography that have enabled industry to manufacture the current generation of nanoscale circuits and begin development of the next generation. The foundation of all modern-day electronics is the use of light to define the patterns used to create integrated circuits. As the dimensions move deeper into the nanometer scale, performing such lithography with light becomes increasingly difficult, requiring advanced technology to overcome the physics that limit the dimensions to the light's wavelength. To manufacture current electronics with a 32 nm feature size, "deep ultraviolet" (DUV) lithography is required, an approach that uses an immersion technique to overcome this limit. Design of DUV systems was made possible by accurate measurements by NIST of all the key optical properties of the immersion fluid, including the crucial refractive index, which was determined with an accuracy a thousand times better than previously known. Further reduction in circuit size will require "extreme ultraviolet" (EUV) lithography, a method that depends on special mirrors which must maintain their reflectivity under long periods of harsh illumination. To help industry overcome this hurdle, NIST has developed a new, highly reliable technique to identify contaminants in industrial production environments. The new technique has been adopted by manufacturers in their preproduction tools, providing a key step towards producing the next generation of nanoscale electronics. By working directly with industry, including Intel and SEMATECH, these accomplishments help maintain US leadership in semiconductor electronics.

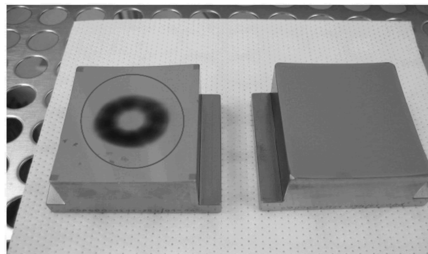

Figure 1. An EUV mirror (left) showing a ring of damage caused by contamination, contrasted with a new mirror (right).

References/Publications/Patents

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