

Contact line Dynamics in Immersion Lithography- Dynamic Contact Angle Measurement

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Abstract

The optical performance of wafer scanners is improved when a thin water layer is present between the lens and the wafer. In this process water is supplied and extracted below the lens. Due to high speed scanning movements the contact line is deformed, instabilities in the interface occur. This may cause water loss in the form of small droplets at the receding side of the interface. This droplet formation causes several problems and must be avoided. On the other side of the interface bubbles can be entrapped into the liquid, causing imaging defects. Contact line instabilities are dominantly influenced by the surface properties and therefore a good understanding of contact line dynamics in relation to the surface properties is essential for the development of immersion lithographic tools.

ASML has developed a method to determine the dynamic contact angle with a system that is representative for the immersion system used in the lithographic tools.

Water is supplied by a needle and extracted through a concentric ring around this supply needle. A turn table is used to accelerate the surface, while the meniscus profile is captured with a high-speed camera. An imaging tool has been developed to measure the receding and advancing contact angle as function of the wafer surface velocity.

With this set-up wafer coatings and immersion fluids are characterized

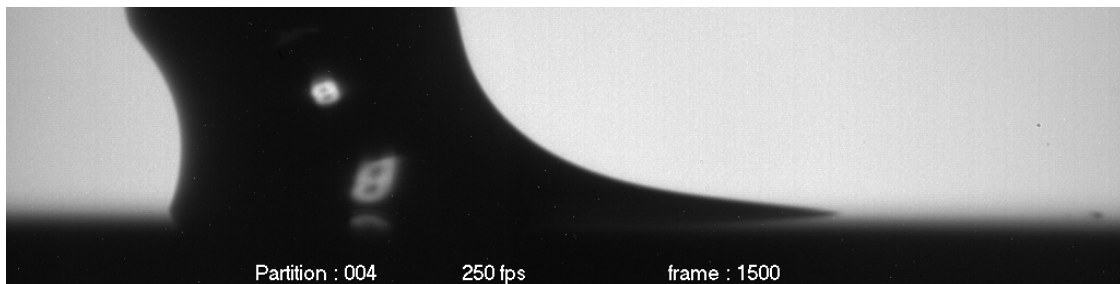


Figure 1, Dynamic Contact Angle measurement. (deformation of a circular contact line due to a scanning movement, picture ASML)