NEBRASKA CENTER FOR MATERIALS AND NANOSCIENCE AND CENTER FOR NANOHYBRID FUNCTIONAL MATERIALS

Seminar

Thursday Oct. 27, 2011

3:30 pm N129 SEC

Ellipsometric study of carbon contamination and cleaning of EUV mirrors

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Extreme ultraviolet lithography (EUVL) is a next generation photolithographic technique that uses 13.5 nm or Extreme UV radiation and multilayer coated reflective optics. The reflectance of these optical elements can be strongly reduced when, as a consequence of exposing the optics to EUV photons, a contamination layer is built up on the mirrors. A very thin contamination layer already reduces the reflectivity of the mirrors substantially. The direct observation of the EUV reflectance of the mirrors is hardly possible since the required accuracy can only be achieved in very sophisticated lab reflectometers. The use of spectroscopic ellipsometry in the VIS-NUV has been evaluated as a tool for the necessary contamination as well as cleaning procedures.

The viability of spectroscopic ellipsometry for monitoring carbon contamination was evaluated by characterizing mirror material with a varying thickness of both EUV induced carbon deposits as well as a graphite film. We found that ellipsometry is able to provide both thickness and the type of carbon layer, i.e. hydrogenated carbon or graphite like material. From the type of carbon and the thickness of the layer, an estimation of the change in reflectivity in the EUV range can be made. A comparison of the measured and predicted change in reflectivity in the EUV shows that spectroscopic ellipsometry is suitable to accurately estimate the EUV reflectance loss.

Atomic hydrogen cleaning is considered as one of the most efficient methods for cleaning carbon contamination in the EUV lithography environment. With *in situ* ellipsometry, the etch rate of atomic hydrogen cleaning for three different kinds of carbon films was investigated. We found that the etch rate depends on the carbon type (polymer- or graphite-like), layer thickness and temperature. The polymer-like EUV induced carbon shows the highest etch rate, while the more graphite-like carbon layers showed an etch rate that was an order of magnitude smaller. Moreover, ellipsometry provides an excellent end point detection for the cleaning procedure.

Seminar hosted by Dr. M. Schubert,
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