The influence of Extreme UV light on the oxidation of optical components

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A capping layer on mirrors for EUV lithography equipment [1] is necessary to prevent or mitigate surface oxidation. It has been recognized that exposure to EUV light enhances oxidation as well as carbon contamination at the surface of the mirrors [2]. This leads to an undesirable and irreversible loss of reflectivity. Ru is a candidate material for a capping layer, because of its high reflectivity for EUV [3] and high oxidation resistance [1]. Experiments in combination with modeling were carried out to study the oxidation mechanism and kinetics of Ru when exposed to EUV. At the Ru surface secondary electrons are generated by the EUV radiation. The effects of these secondary electrons on the surface oxidation of Ru were simulated with a low energy electron beam. In a UHV processing chamber, a bare single crystal of Ru was exposed to dry oxygen at various pressures (between 10^{-4} Pa and 1 Pa) and temperatures (between room temperature and 400 C). Meanwhile the development of the oxide layer was monitored with *in-situ* ellipsometry. After the oxidation process, XPS and LEED spectra of the Ru surface were recorded to analyze the nature of the oxides formed. Initially a slow growing oxide film develops. Next, depending on the oxygen partial pressure and temperature, the oxide film growth increases. This change in oxidation kinetics is associated with the change of the type of oxide formed on the surface.

References

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