



1. Title:	Contamination Cleaning of Ru-capped EUV Multilayer-Mirror with Atomic-Hydrogen
2. Full names of all authors:	Iwao Nishiyama, Kumi Motai, Shinji Miyagaki, Hiroaki Oizumi, Tomoya Ueno, Akira Izumi and Akira Namiki

3. Abstract body:

Since the projection optics in EUV lithography require a very long reflectivity lifetime, contamination control is very important for EUV multilayer mirrors. Under EUV irradiation in a partial vacuum, the primary sources of contamination that degrade reflectivity are: (1) carbon contamination produced by the photodecomposition of background organic molecules, and (2) surface oxidation of the capping layer caused by a reaction with background H₂O induced by EUV radiation. Methods of removing carbon contamination already exist, but there are none for oxide. Thus, there is great need of a new technology that removes both. Our solution is to treat the surface of EUVL mirrors with atomic hydrogen, which can be generated by heating a catalyzer consisting of a W wire. The surface composition of a Ru-capped mirror contaminated with carbon or oxide was measured by XPS and AES before and after treatment. After treatment, the amount of carbon on the mirror surface was lower, and the amount of oxygen was comparable to that of an as-deposited sample on which native oxide had formed. The EUV reflectivity of a multilayer mirror was also measured before and after cleaning, and atomic-hydrogen treatment was found to restore the reflectivity, which was degraded by contamination.