Cleaning of the first mirror by selective ion etching

N.B Koster[1], P. Kudlacek[2], T. Huijser[1], M.C.M. van de Sanden[2]

[1] *TNO Science & Industry, POBox 155, 2600 AD Delft, The Netherlands*
[2] *Eindhoven University of Technology, Department of Applied Physics, POBox 513, 5600 MB Eindhoven, The Netherlands*

Corresponding author: norbert.koster@tno.nl

The first mirror in the diagnostics for ITER is prone to be contaminated with carbon and beryllium due to the erosion of the plasma facing components. Estimations about the flux of contaminants indicate that the mirror will be out of specification within a few days. A cleaning method for the first mirror is therefore essential. It is known that hydrogen radicals are capable of removing carbon contamination and with a hydrogen radical generator it is possible to clean the mirrors from carbon contamination [1]. However not all contaminants can be removed using hydrogen radicals, some metals may form volatile hydrides when exposed to radicals. Unfortunately Be doesn't form a stable hydride at the temperature ITER is operating and therefore another cleaning method is needed. We will show our research on the possibility to remove Low Z metal contamination from Mo mirror surfaces using energy dependent ion sputtering without loss of optical performance of the mirror surface. The experiments are performed on the pulsed biased expanding thermal plasma source at the Eindhoven University of Technology [2]. For operation in ITER another type of source may be needed due to the design constraints. The design of such a source is not a part of this research. We have focused our investigation on Carbon and low Z metals like Aluminum or Magnesium and have determined sputter yield for these materials at very low ion energy. Due to safety regulations regarding Beryllium we have chosen to use Al or Mg as a substitute for Be. Because Be has a lower atomic weight than Al or Mg it is expected that the sputter yield is higher or at least comparable with Al or Mg. Further we investigated the damage threshold for amorphous Mo samples in order to determine maximum ion energy for removal of C and low Z materials. Finally a crystalline Mo surface has been exposed to the desired ion energy to verify that no damage occurs on the mirror surface due to preferential etching along the lattice boundary.

[1] N.B. Koster et al, EUVL Symposium 2008, Lake Tahoe, http://www.sematech.org/meetings/archives/litho/8285/pres/CP-03-Koster.pdf
[2] P. Kudlacek, R.F. Rumphorst and M.C.M. van de Sande, JAP 106, 073303, 2009