IEUVI Contamination
&
Optics Lifetime TWG

Japan Update

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Extreme Ultraviolet Lithography System Development Association (EUVA)
Canon Inc.

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Active Organization and Topics

	PO Contamination & Lifetime		
Reduction of Deposition	**EUVA**	**ASET**	
Cleaning	**EUVA**	**ASET**	**Univ. of Hyogo/LASTI**
Oxidation	**EUVA**		
Outgassing		**ASET**	**Univ. of Hyogo/LASTI**

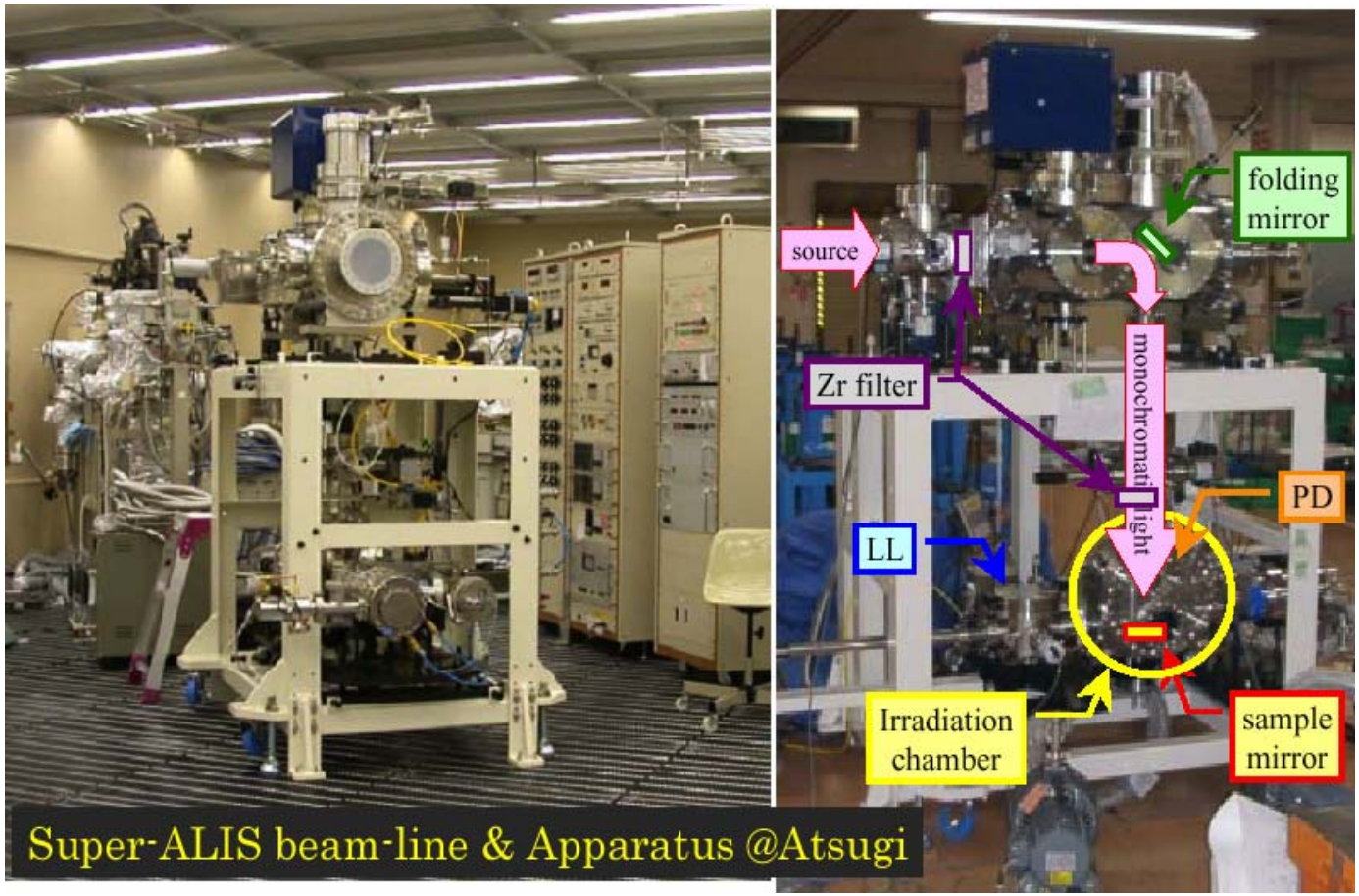
Recent progress on Contamination control at EUVA:

1. Completed an experimental setup at NTT. SR source is used for experiments. UV+O_2 cleaning is started.
   EB irradiation setup is also available.
   T.Aoki, *et al.* 5751-139

2. Surface analyses have been performed. XPS analysis showed Mo in the ML remains metal state, not oxidized.
   H.Takase, *et al.* 5751-132

3. Reflectance changes due to intense EUV light irradiation was measured with different water pressures.
   Y.Kakutani, *et al.* 5751-130

Experimental Setup

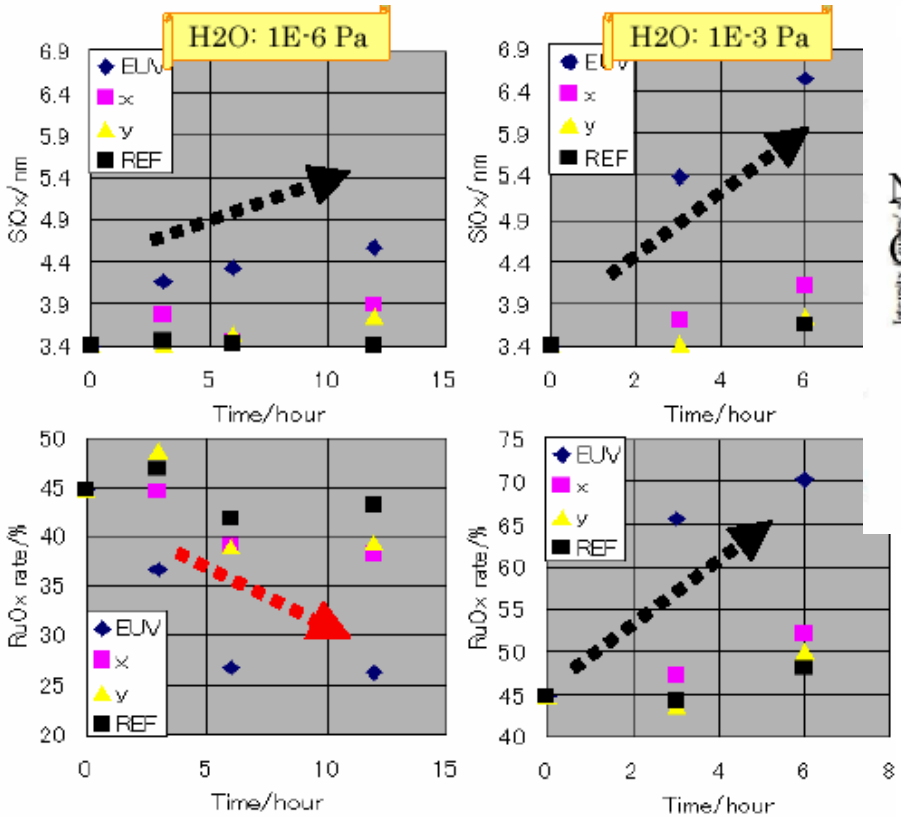


A loadlocck system installed.

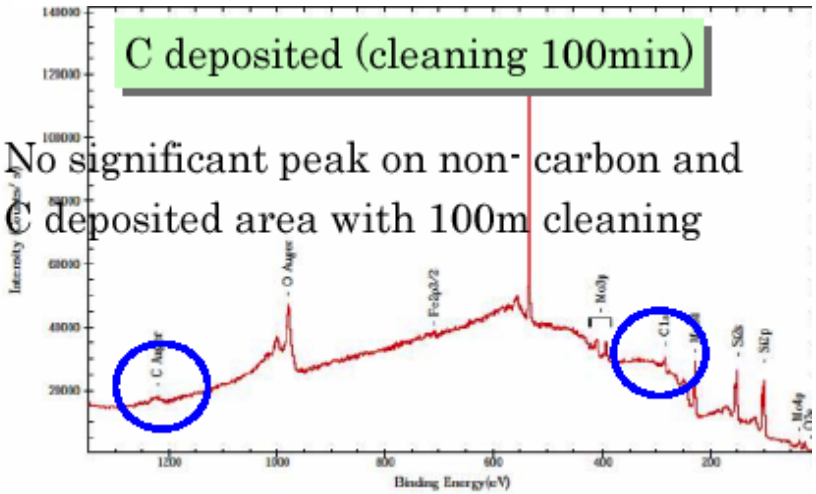
EUV power density 16 mW/mm^2.

EB irradiation unit is also available.

Irradiation study at NTT



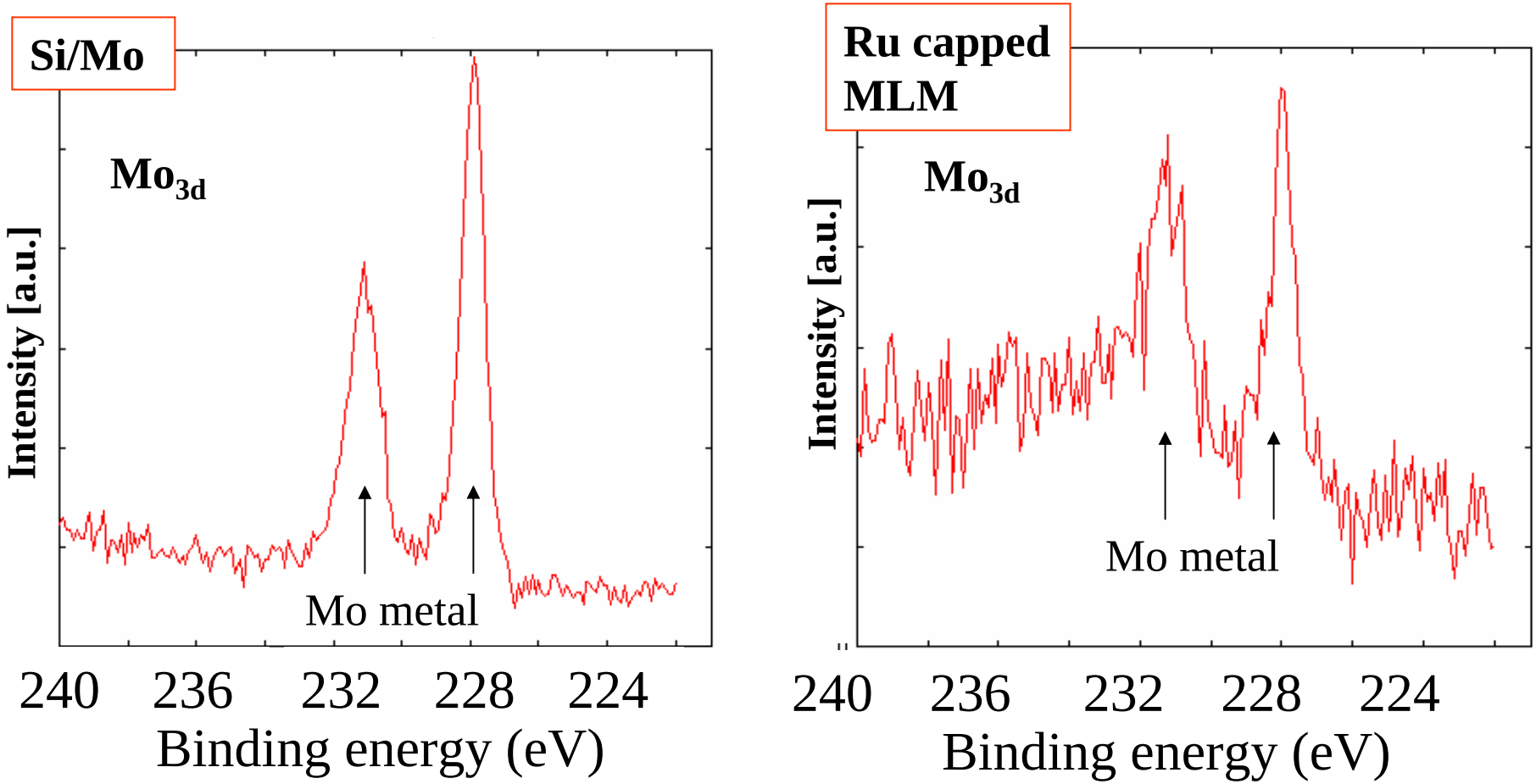
Si (upper) and Ru capped multilayers are irradiated at 16 mW/mm^2 for 4 hours.



A 100-minute cleaning with UV (172nm) +O_2 makes carbon peaks disappear in the XPS chart.

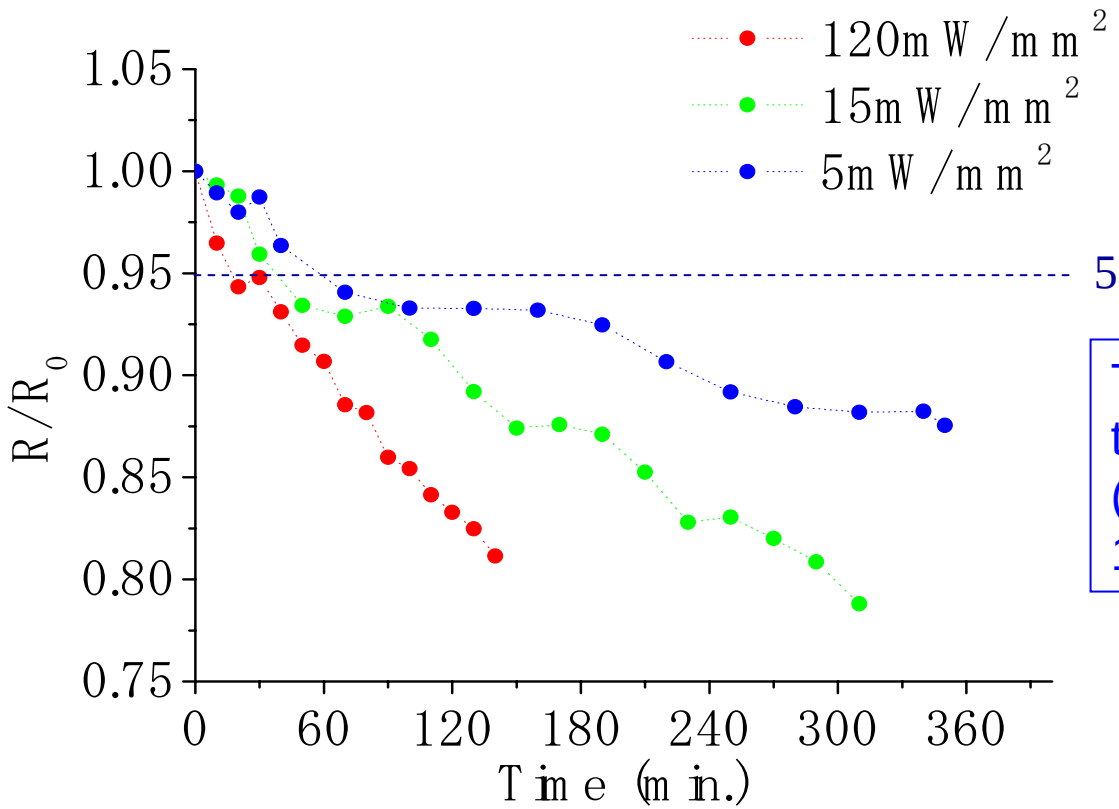
Oxidation of top-surface materials are investigated under several water partial pressure conditions. Ru capping layer remains the same state of oxidation or even reduced at 1x10^{-6} Pa of water.

The effect of water pressure on Mo (XPS)



Mo kept metal state even under $1x10^{-3}$ Pa of water pressure in both case of a Si/Mo and a Ru capped MLM.

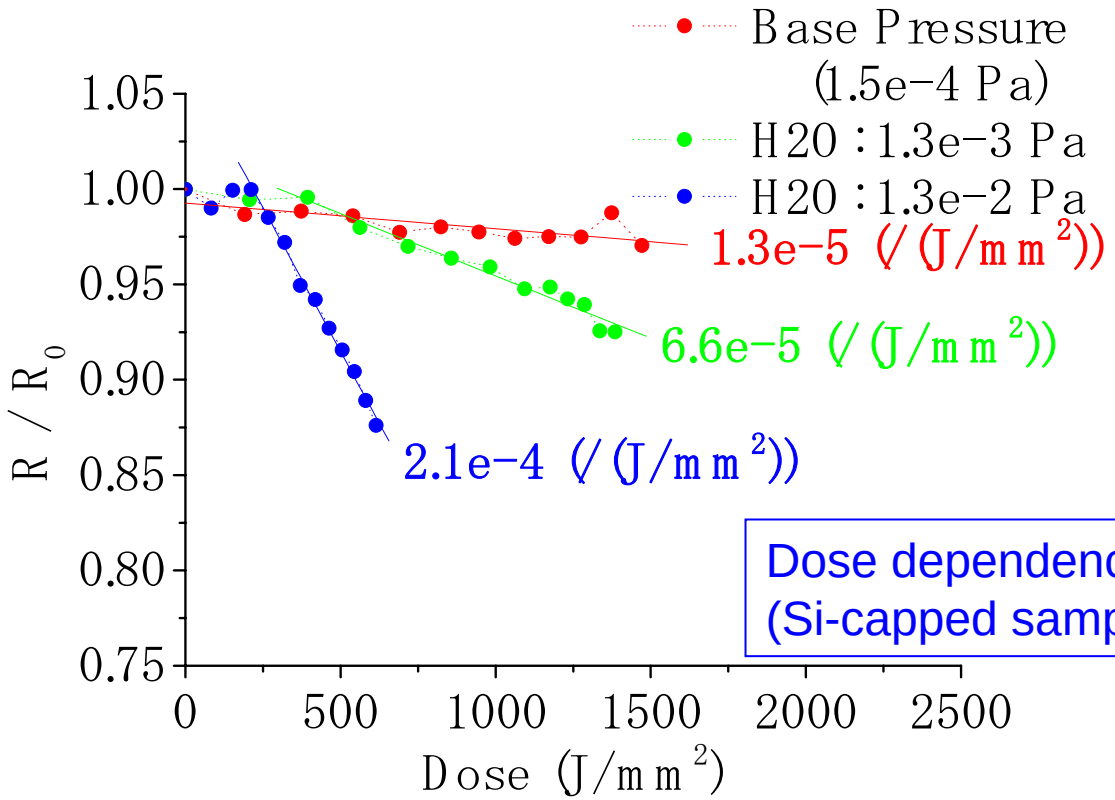
Intensity Dependence



Time dependence of the reflectance (Si-capped sample at 1.3×10^{-2} Pa H_2O)

Time dependence of the relative reflectance irradiated at three different EUV powers with 1.3×10^{-2} Pa H_2O. The stronger the EUV irradiation power becomes, the sooner reflectance goes down to a certain value.

Water partial pressure dependence



Dose dependence of the reflectance (Si-capped sample)

Dose dependence of the relative reflectance measured at three different water vapor pressure at the same EUV power. Reflectance quickly dropped at the higher water vapor pressure. The mechanism of the phenomena seems to be explained by Gomei's model.

Cooperation expected:

* Share data on scaling law---Parameter space

* Perform testing on a neutral ML

* Share general data on fundamental understanding

* Tool makers' list of contaminant materials

* Work together to develop scaling laws for oxidation

* White paper

Cooperation expected:

* Share data on scaling law---Parameter space
  - Intense irradiation, but
    depends on EUVA R&D plan
* Perform testing on a neutral ML
  - Seems helpful, but depends on the schedule
* Share general data on fundamental understanding
  - Possible within published data
* Tool makers' list of contaminant materials
  - TBD
* Work together to develop scaling laws for oxidation
  - Under consideration
* White paper

End