EUVL development activity at Canon

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Illumination optics

EUV transmission by Joint Spec.: 8.4%

Source IF $\xrightarrow{\textit{transmission}}$ Mask

Assuming that a mirror number in illumination optics is 6 and an average reflection rate is 0.66,

$$0.66^6 = 0.083.$$

Additional loss may have to be counted depending on source etendue and illumination optics. The most important component is the mirror to form ring-field illumination. Evaluation of polishing of mirror surfaces is in progress

Projection optics

Projection optics (PO) design

Mirror metrology and machining

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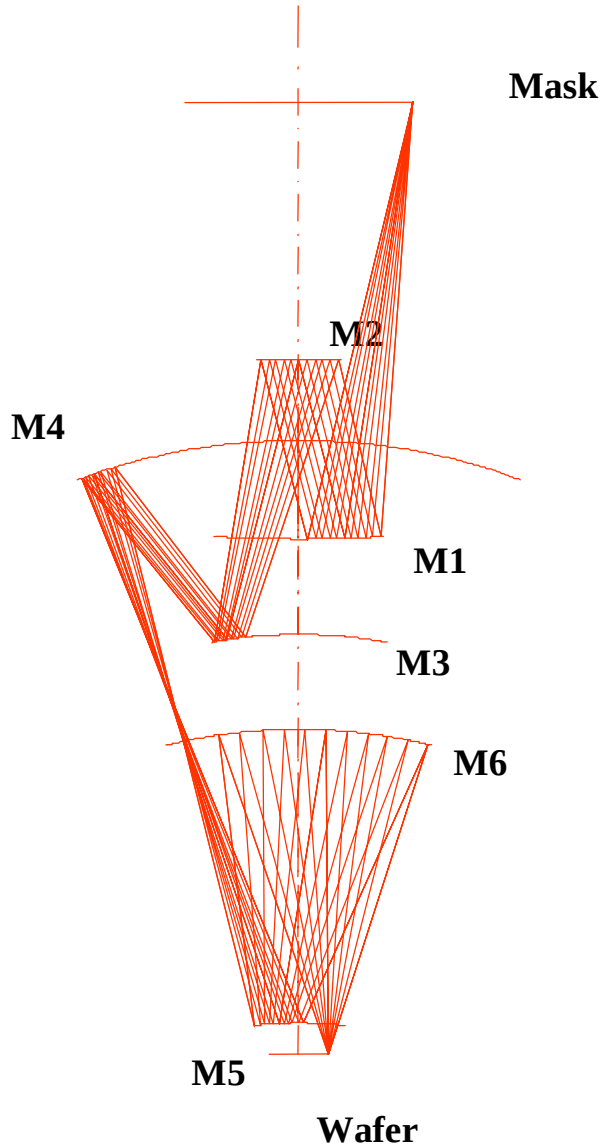
Contamination study

Optics design



NA: 0.25

Field size: 26x33 (mm)

Design wavefront: ≤20mλ

Target wavefront: ≤ 50mλ

The design of the M4 mirror is the most crucial point.

Optical design is finished and mechanical design of the PO box is in progress (fixturing, sensing and adjusting)

Mirror metrology and polishing

An interferometer for aspheric figure and near-intermediate range evaluation is being characterized. The target accuracy is 0.1 nm.

Polishong:

Advanced small tool technology,

Ion beam figuring (EUVA project: OpP04-06),
(collaboration with Tokyo Univ. Science)

Target figure frequency; 3-30 mm

Beam size; 1-3 mm

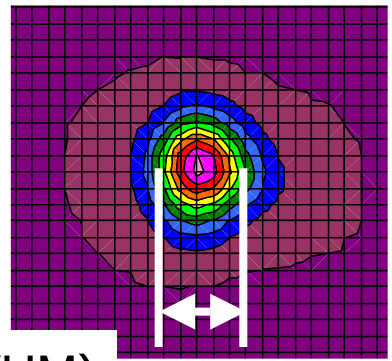
Elastic emission machining (EUVA project).

Final surface smoothing.

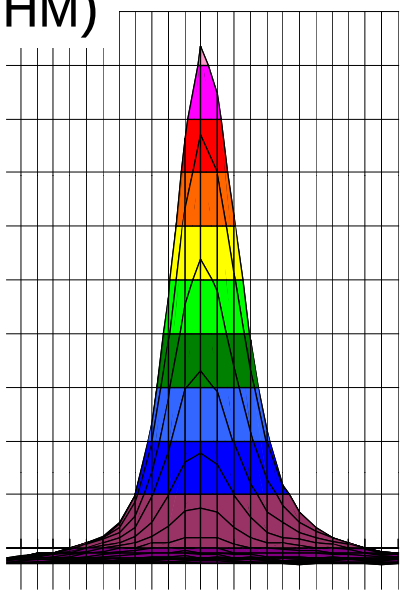
First result of IBF (EUVA project)

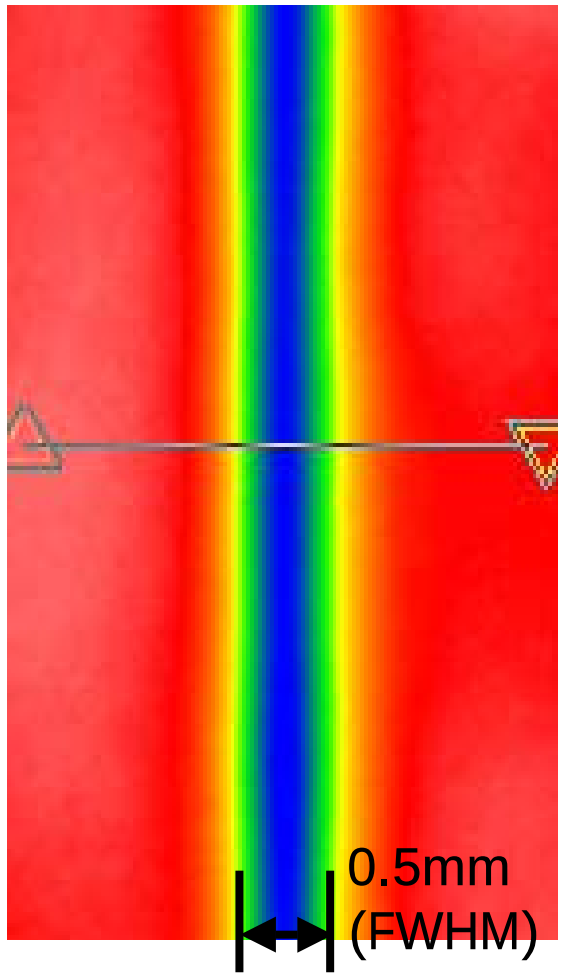
(Ion beam current density profile)

Accelerating voltage : 20kV
Work-piece : Si



Φ 0.5mm(FWHM)





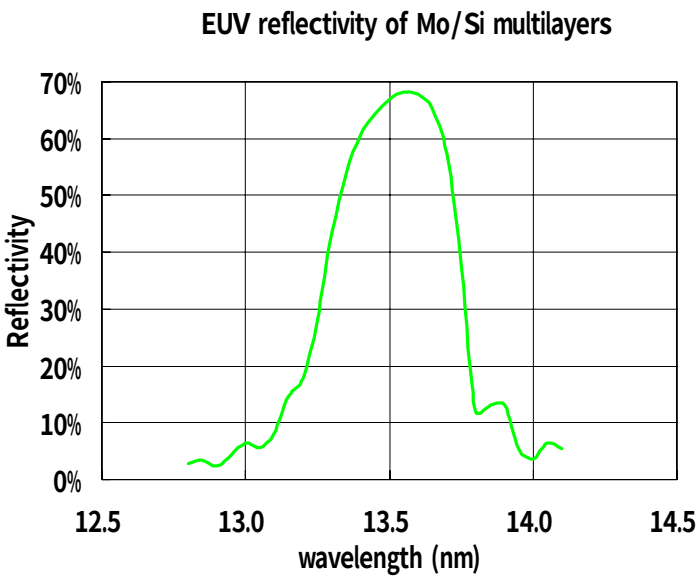
Multilayer coating

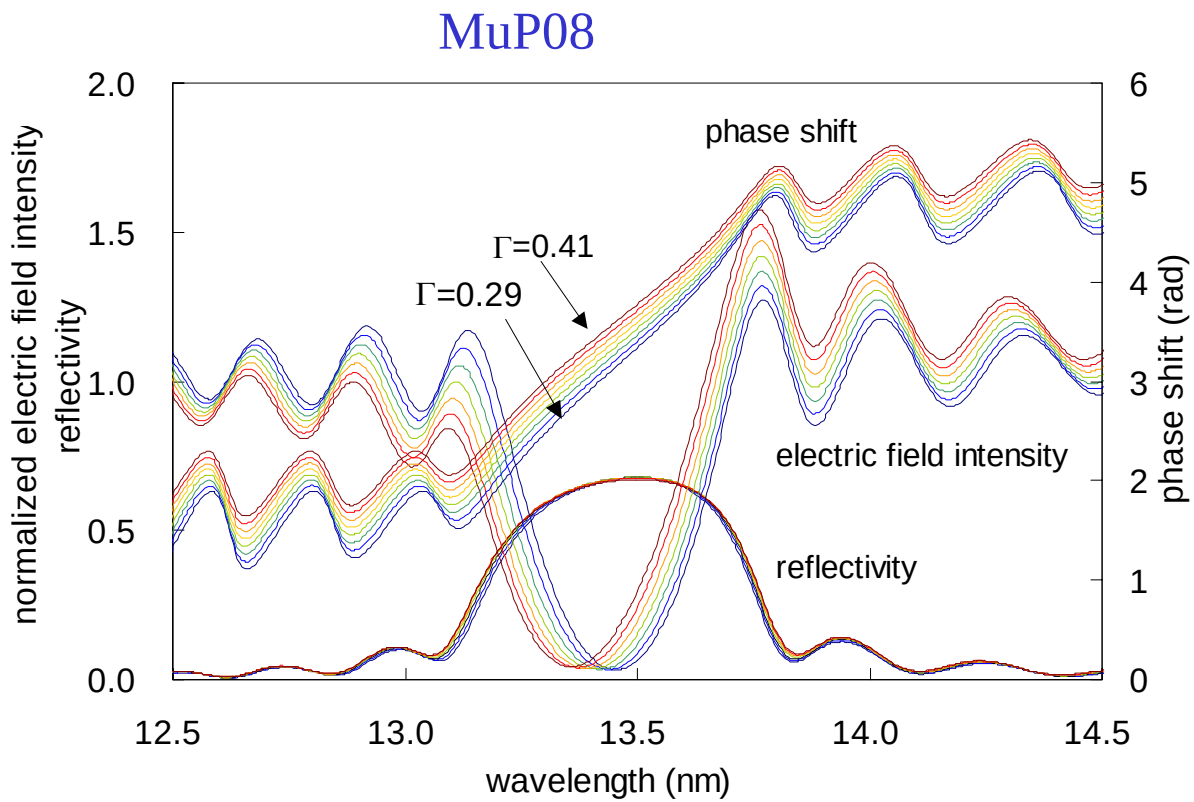
Various shape and surfaces for both illumination and projection optics need to be coated.

Production level machine is installed and being tuned to meet the stringent requirements: reflection rate; uniformity; and layer stress.

EUV reflectometer has been working in 3 years and the coating can be well characterized including some of the phase structure information

Multilayer coating





Wavefront evaluation

First characterization: visible interferometer

Light throughput; $0.5^6 = 0.016$

Single path metrology is required.

Distortion measurement of 6 mirror optics

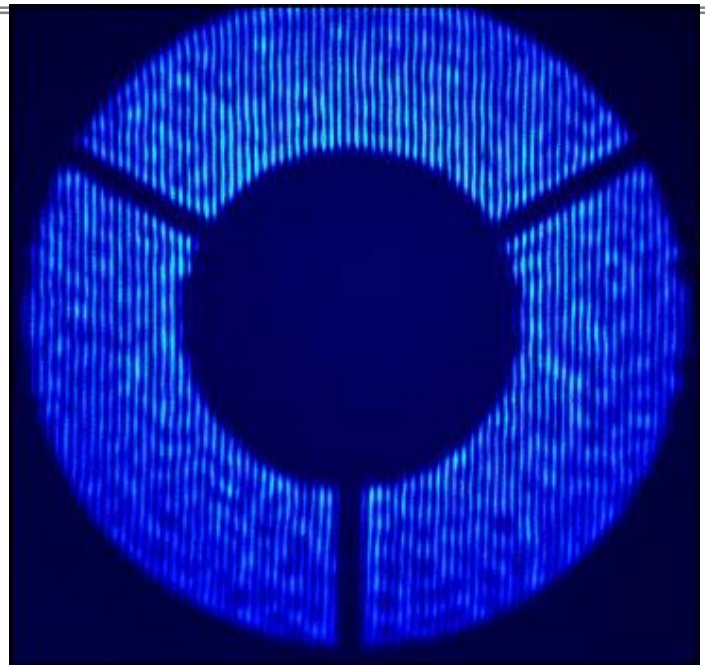
Instruments for single path metrology has been built and being characterized for 0.25 nm accuracy measurement.

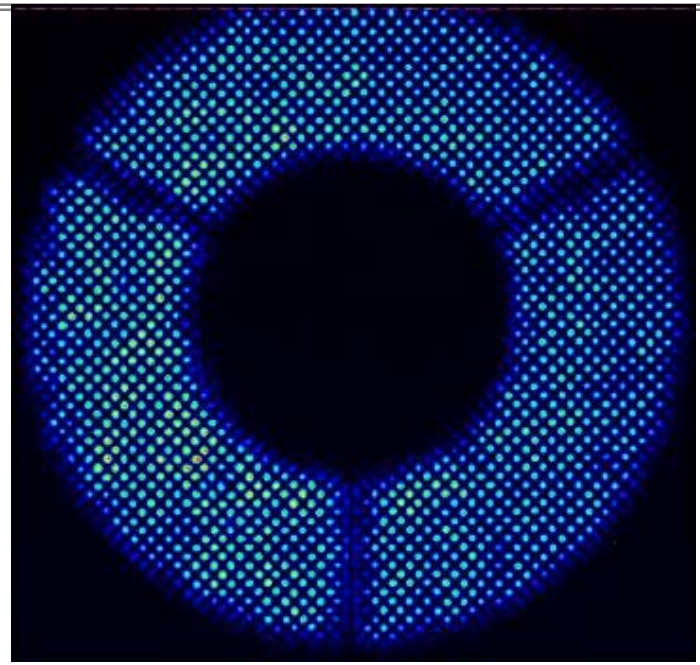
Installation for 6 mirror optics evaluation will be ready in 2006.

At-wavelength characterization: EUVA project

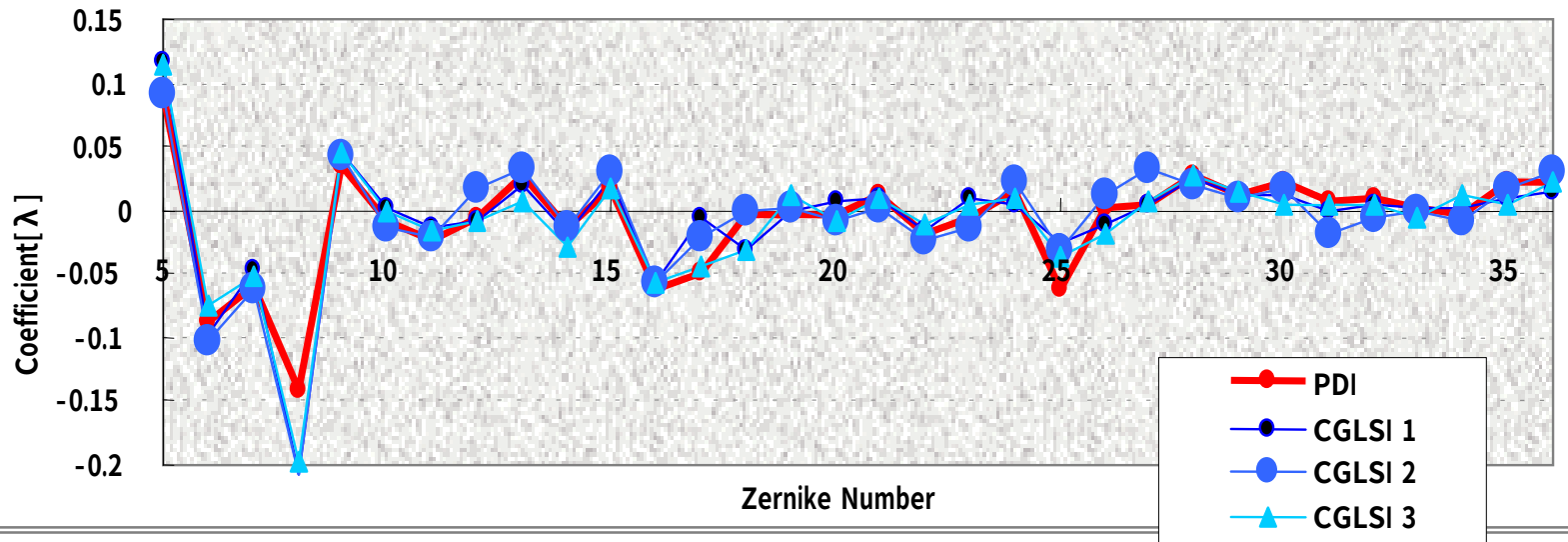
(NewSUBARU, Univ. Hyogo)

At-wavelength characterization (EUVA project: MeP15)





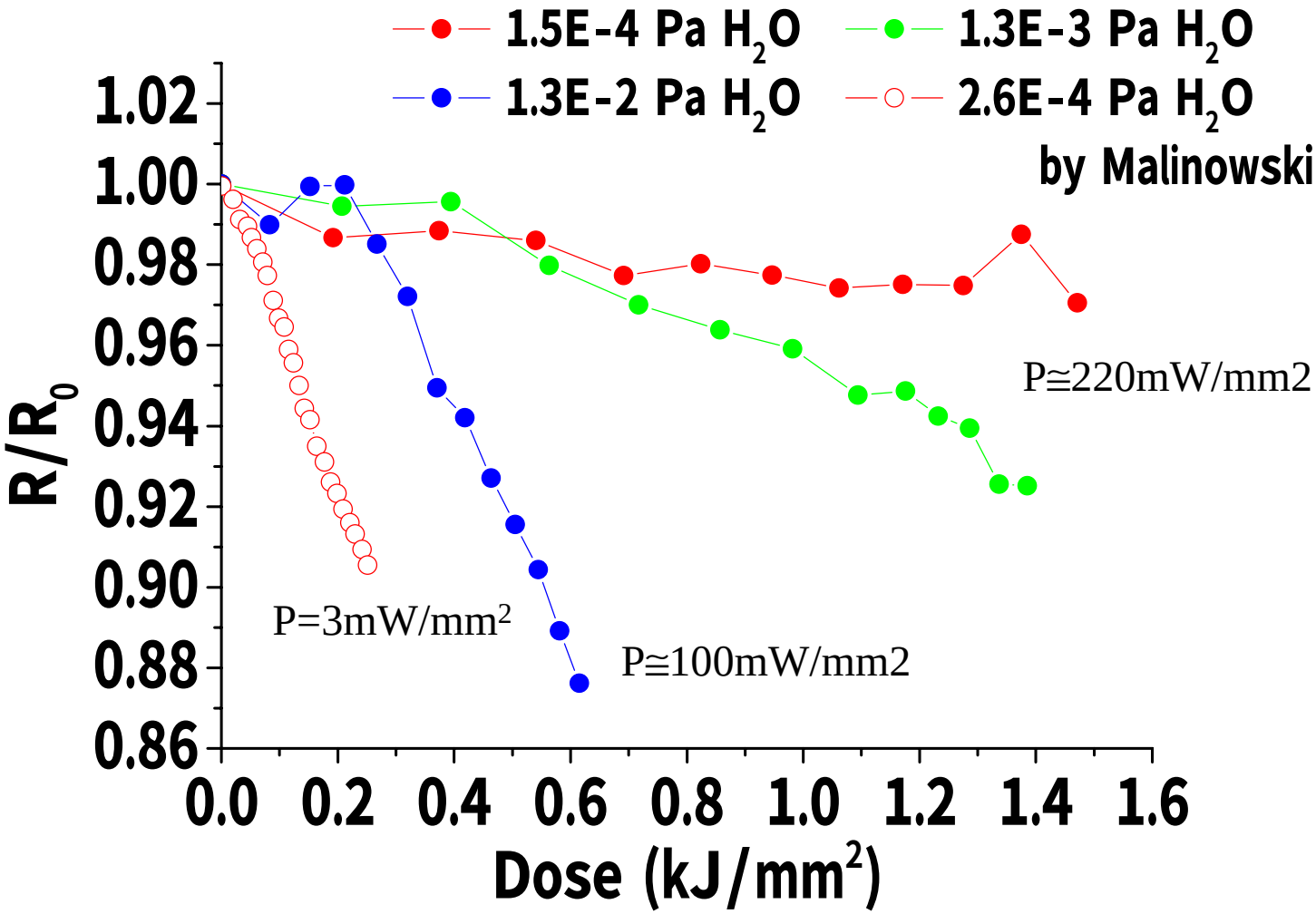
Comparisons PDI and CGLSI



Contamination study (EUVA project)

Model for acceleration test: $\int P\sigma_i dt \propto \Gamma_i^{1/n} P^{(1-1/n)}$ (CoP17)

Experiment at University of Hyogo for Si capping (CoP18)



Mask handling

Various technique to mitigate mask contamination is studied by numerical simulation. Environment design to have thermophoretic protection at mask stages is being conducted.

Materials to be used at the contact part in mask handling are being experimentally investigated.

Standardization on mask carrier is envisaged. The scheme of mask cassette with breezing function has been proposed from Toshiba. This scheme may be useful for EUVL and may be included in standardization activity.

Wafer and mask stages

Test on outgassing characteristics of materials to be used for components in mask and wafer stages were conducted.

Prototype stages were built and the first attained pressure is:

3×10^{-4} Pa in the wafer area,
1×10^{-4} Pa in the mask area.

These values can be reduced by factors to an order by using proper materials and designing vacuum system more carefully.

Tuning of air bearing and mag-lev sliders or linear motors is under way.

Summary

Building the infra-structure to produce EUVL tools is under way.

We are in the process to develop the components which are EUVL-specific, and the most important component is 6 mirror projection optics.

Integration to our α tool will be conducted in the fiscal year 2006.

Ackowledgement

A part of this presentation came from the work conducted as EUVA Project which is sponsored by METI and managed by NEDO.