EUVL Activities in China

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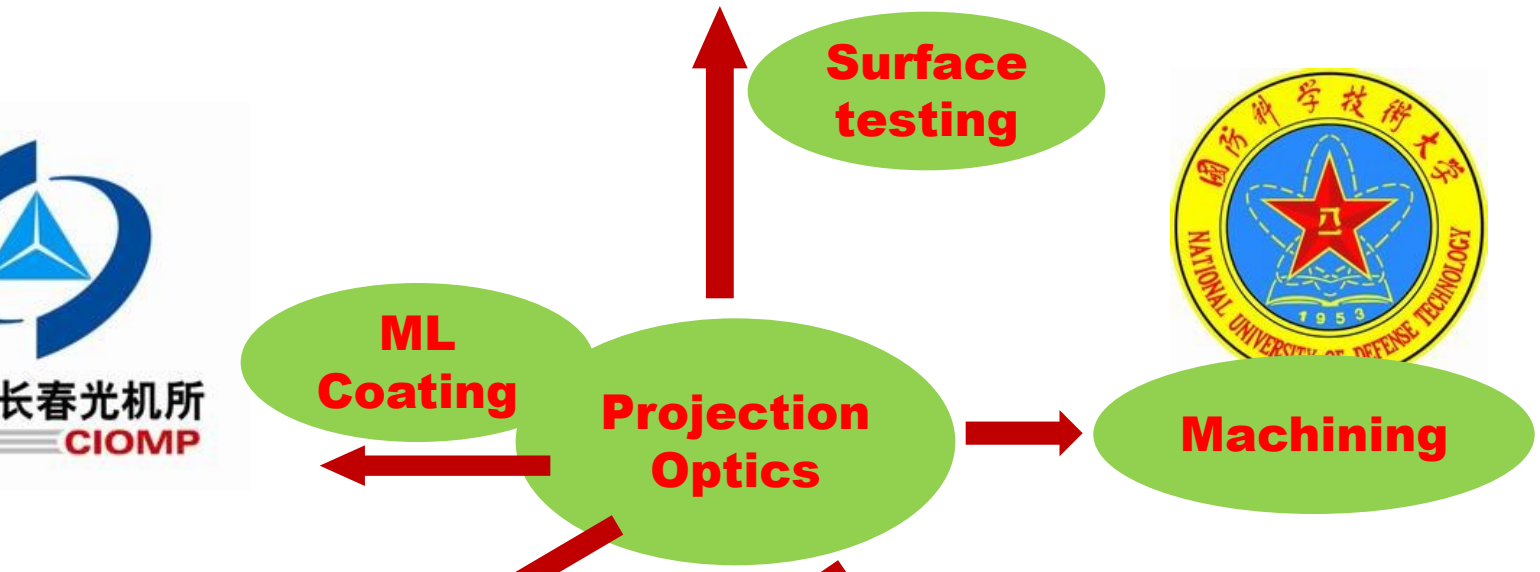
- Projection Optics
  - Imaging System
  - Surface Testing
  - Optical Machining
  - ML Coating
  - Aberration Metrology
- Stage
- Source
- Mask
- Resist

CONTENT

Projection Optics



中科院长春光机所 CIOMP

国防科学技术大学 NATIONAL UNIVERSITY OF DEFENSE TECHNOLOGY 1953

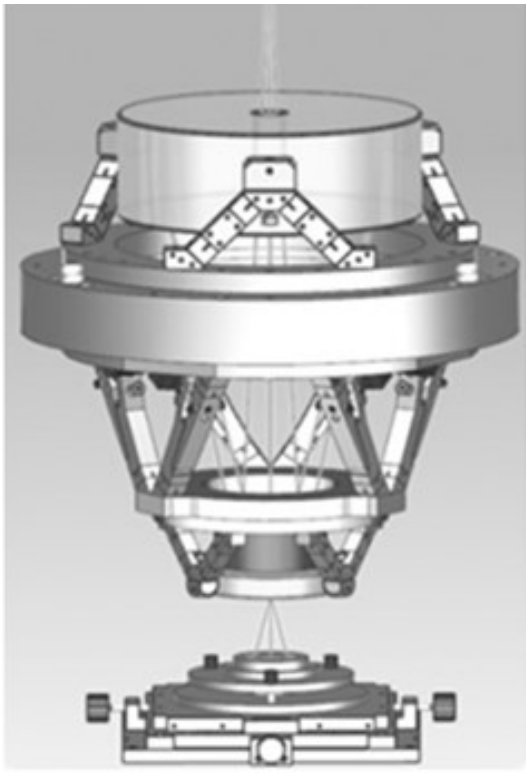
北京理工大学 BEIJING INSTITUTE OF TECHNOLOGY 1940

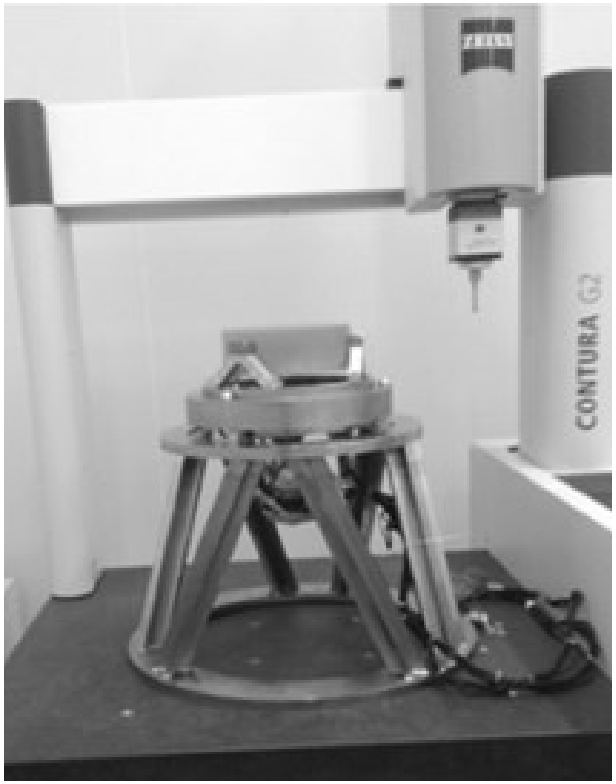
SIOM

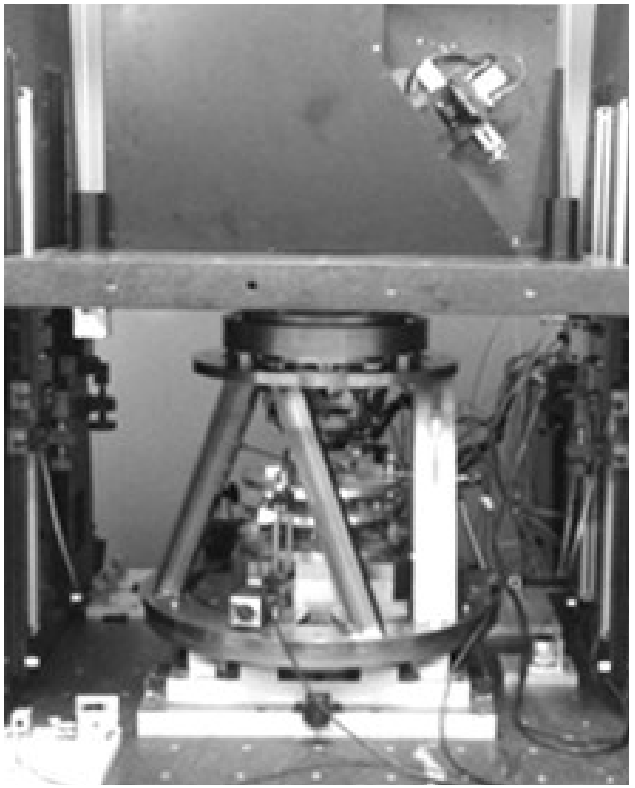
中国科学院上海光学精密机械研究所
Shanghai Institute of Optics and Fine Mechanics
Chinese Academy of Sciences

Imaging System

Changchun institute of optics, fine mechanics and physics (CIOMP)







NA of image：0.25，Field size at wafer：0.5×0.3mm^{2,}

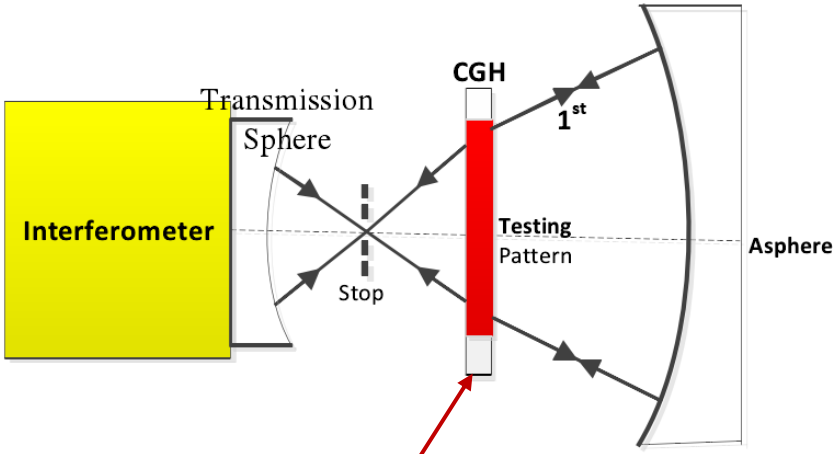
Composite WFE：0.23nm RMS， Reduction Ratio：1/5

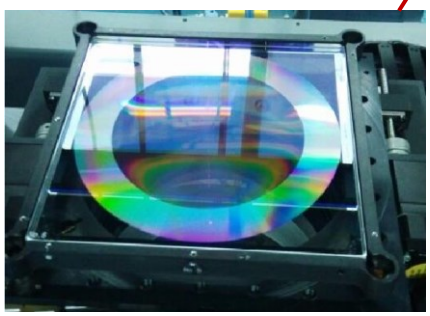
Ref. Optical and precision Engineering, 22(8), 2014: 2103-2108.

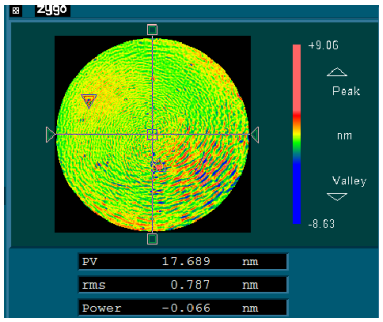
Surface Testing

CIOMP

Aspheric Surfaces testing with CGH



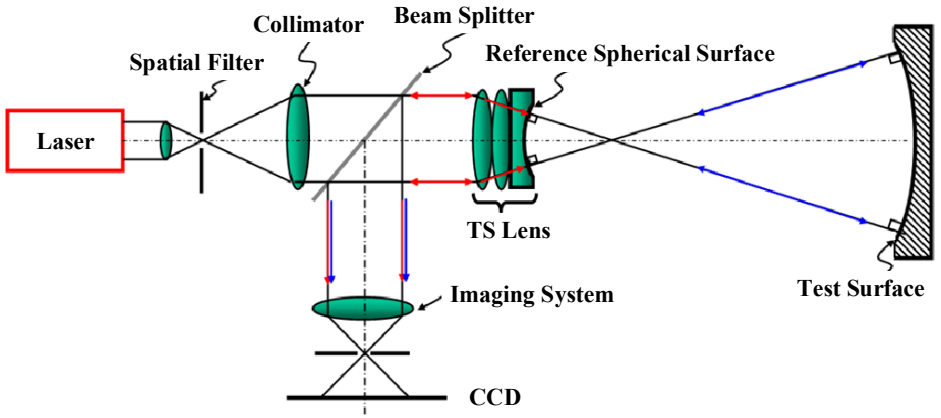


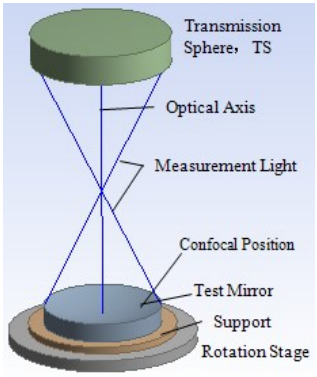


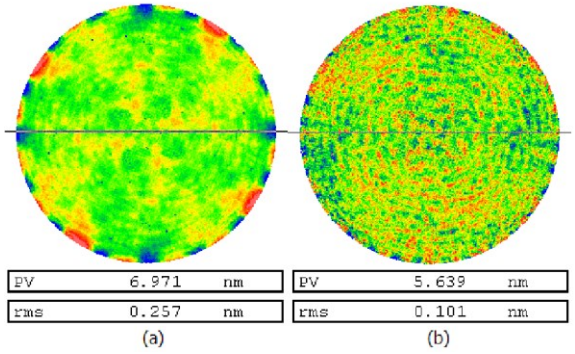
Testing Error: 0.8 nm RMS

Ref. Research on Ultra-Precise Aspheric Surface Testing, PhD thesis, University of Chinese academy of sciences, 2014

Rotationally Asymmetric Surface Testing by Absolute Testing Method





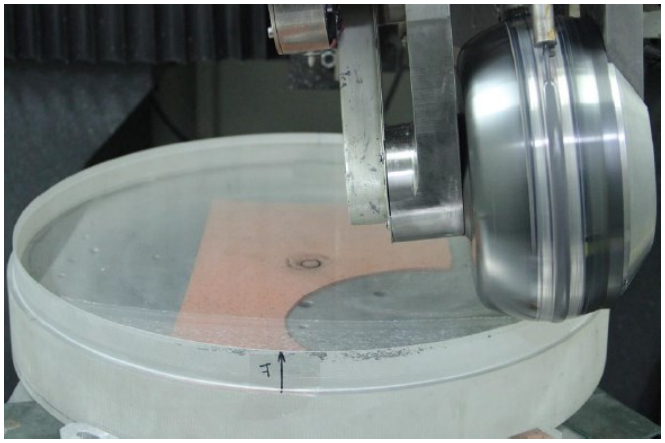


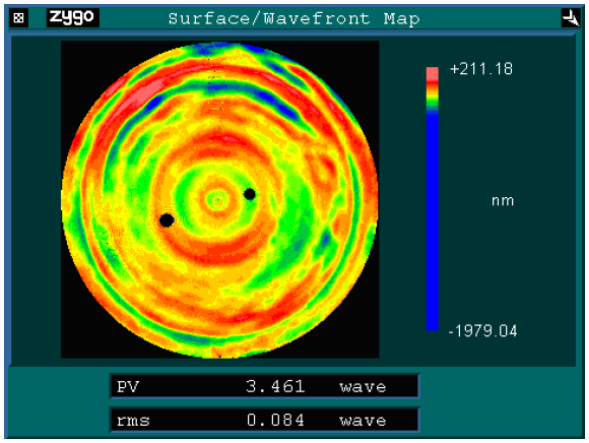
Testing Error: 0.1 nm RMS

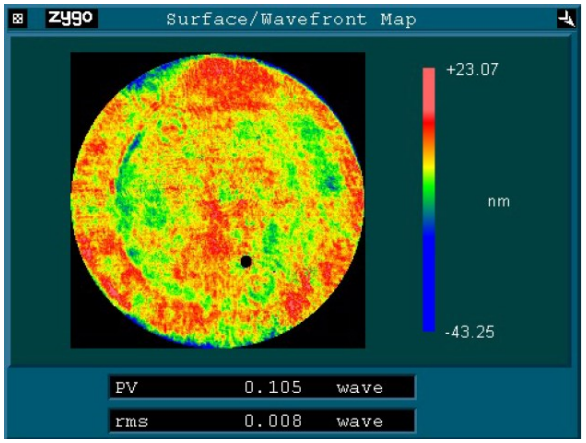
Ref. Research on Rotational Absolute Testing of the Optical Surface, Master thesis, University of Chinese academy of sciences, 2014

Optical Machining

Magnetorheological Finishing (MRF) (0.008 λ rms, λ=632.8nm)

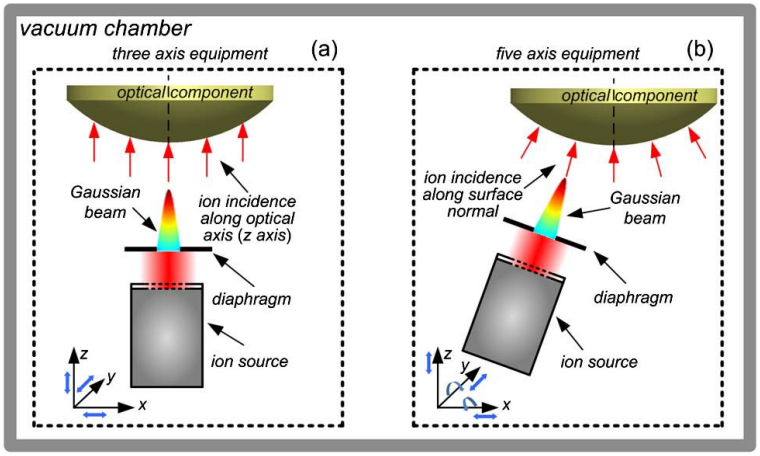




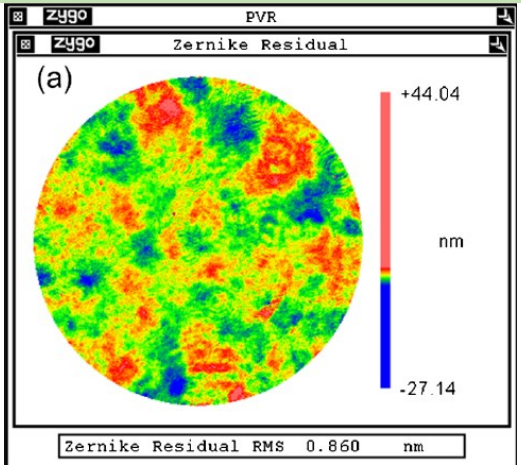


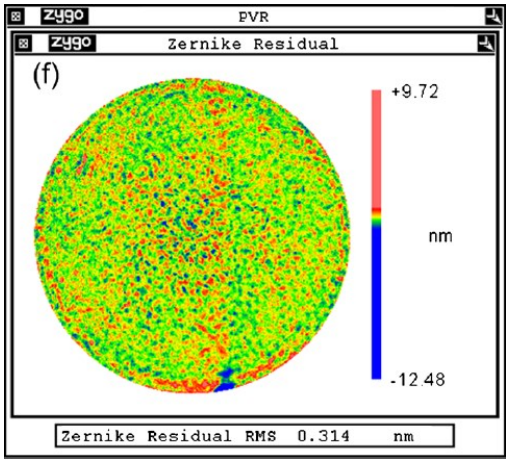
Ref. Proc. of SPIE 9281, 928111, 2014

Ion Beam Figuring (IBF) (0.314nm rms)



Ref. Appl. Opt. 53, 4266-4274 (2014)



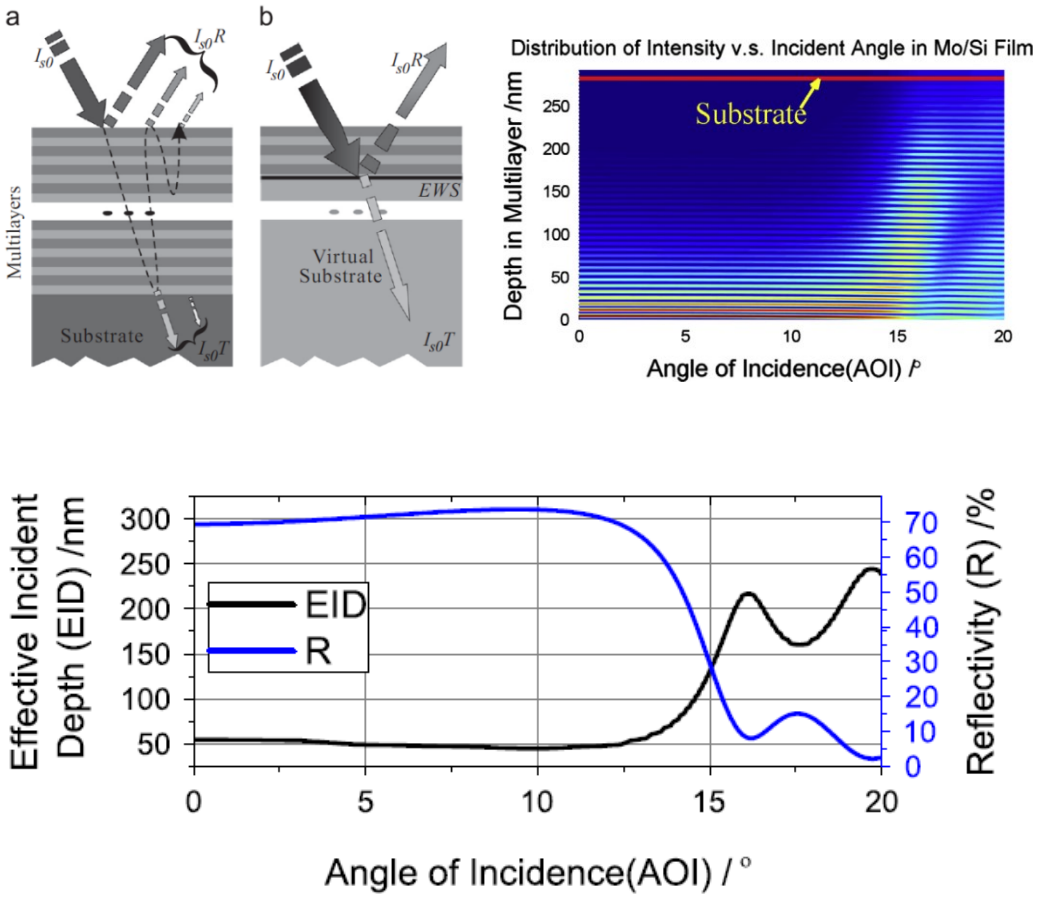


Ref. Optical Engineering 53(9), 095101, (2014)

ML Coating

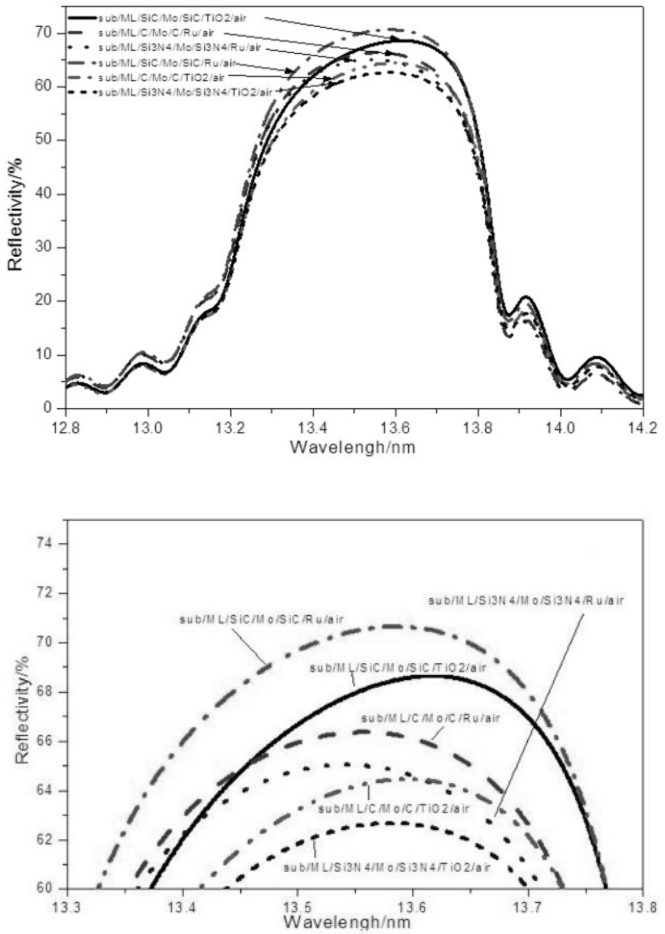
CIOMP

Multilayer analysis model



Ref. Optics Communications 332, 339–342, 2015

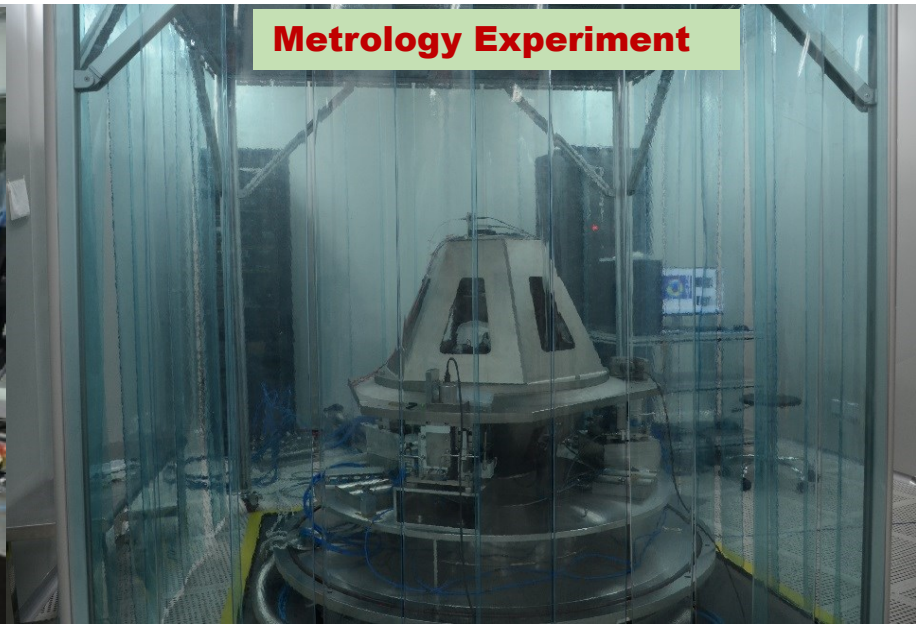
Multilayer design

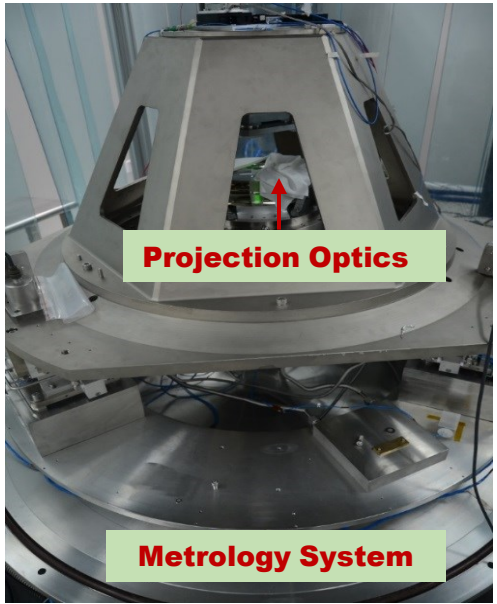


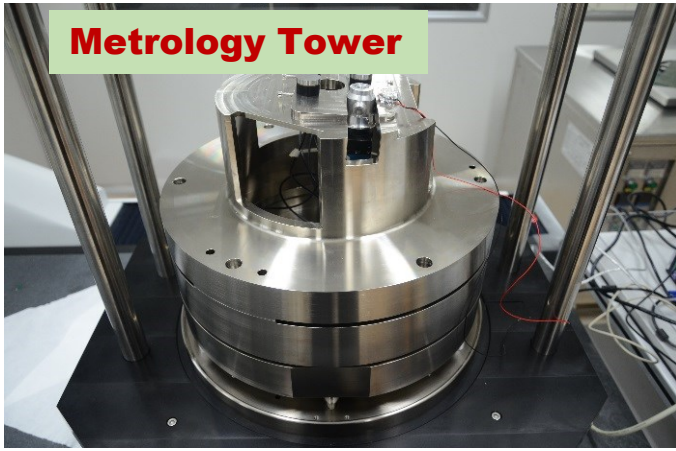
Ref. PRC Patent, CN 104297820 A,2014

Aberration Metrology

Shanghai Institute of Optics and Fine Mechanics (SIOM)



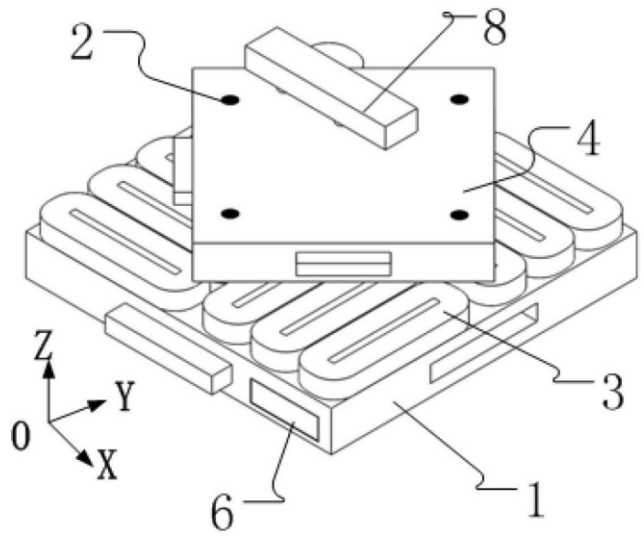


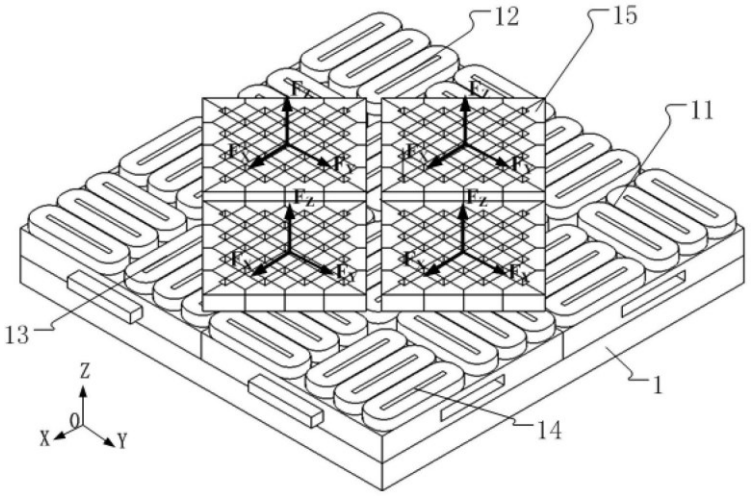


Point diffraction interferometry.
Aberration Metrology repeatability:
λ/10000@532nm;

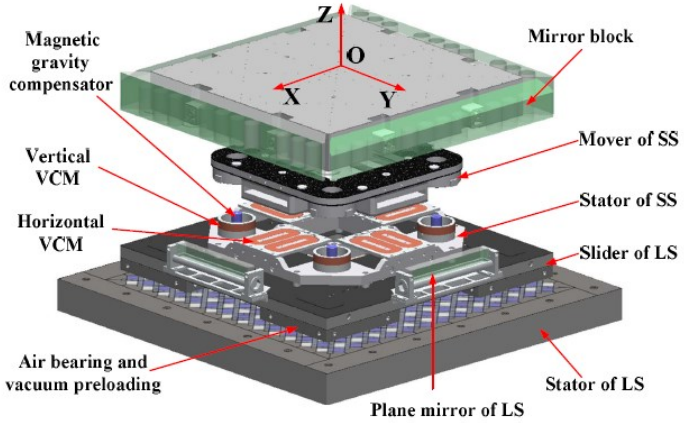
Stage

Tsinghua University **Six degree-of-freedom magnetic levitation micro stage**





Ref. CN 103441708 A, PRC Patent, 2013



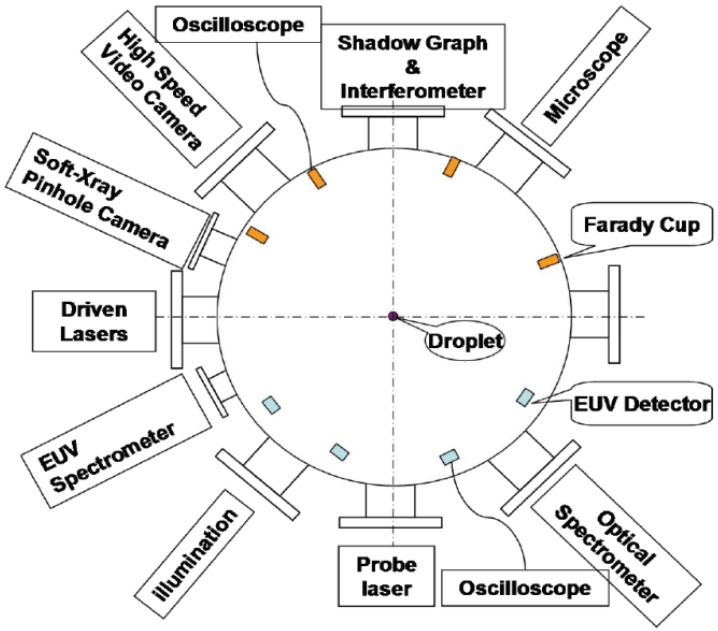
Ref. In Intelligent Control and Automation (WCICA), 2014 11th World Congress on, pp. 2525-2530. IEEE, 2014.

SOURCE

SIOM

LPP EUV source based on Sn droplet

(Goal: 10 W power, 50 ~100kHz repetion rate)



Fundamental Experiment Setup (LPP source)

(Output of 13.5nm EUV light has been achieved)

Sn droplet Generator

(Droplet diameter 100μm, repetition rate 20KHz)

Ref. Poster, international workshop on EUV lithography 2014; Poster, SPIE Advanced Lithography 2014.

SOURCE

Harbin Institute of Technology

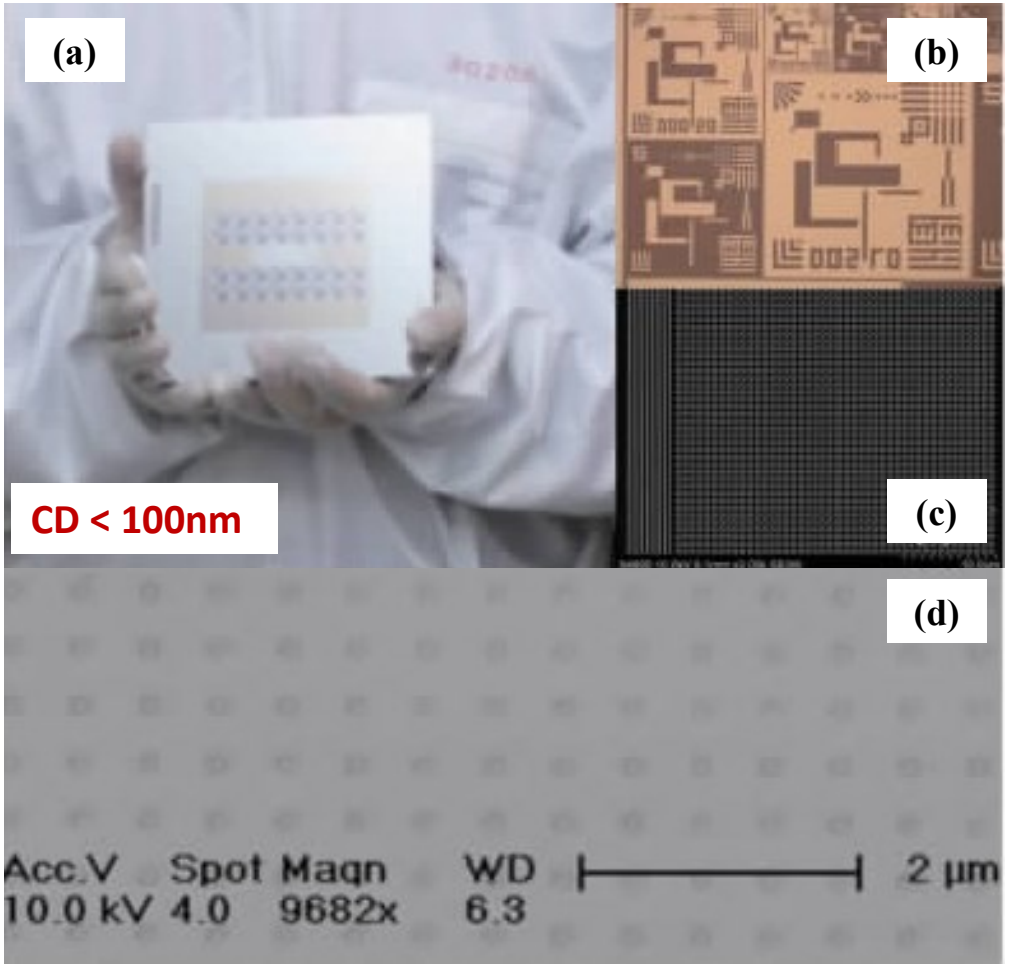
- Influence of capillary inner radius on Xe gas discharge extreme ultraviolet source, Infrared and Laser Engineering, 43(9) 2873 (2014)
- Time behavior and optimum conditions for the Xe gas extreme ultraviolet source, Acta. phys. Sin, 62(24) 245204, (2013)
- Influence of plasma size on discharge extreme ultraviolet source, High Power Laser and Particle Beams, 25(10)2631,(2013)

Huazhong Univ. of Sci. & Tech.

- Experiment study on laser produced tin droplet plasma extreme ultraviolet light source, Acta. phys. Sin, 64(7) 075202, (2015)
- Emission properties of Tin droplets laser-produced-plasma light sources, Proc. SPIE. 9048, 90481V-1, (2014)
- Detecting tin droplet used for EUV source, High Power Laser and Particle Beams, 26(12) 121005-1,(2014)
- Influence of capillary inner radius on Xe gas discharge extreme ultraviolet source, Infrared and Laser Engineering, 43(9) 2873 (2014)

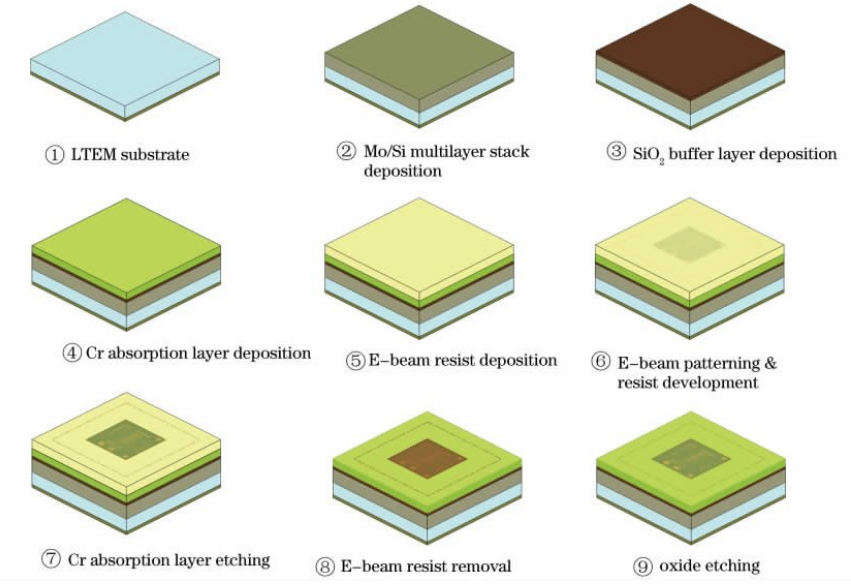
MASK

Inst. Of Micro. Of CAS.

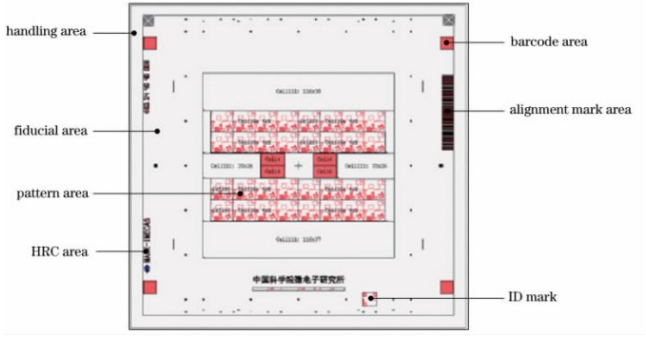


EUVL mask fabrication (32nm node)

Fabricated EUVL mask. (a) photograph of the mask, (b) microscope pictures of the mask patterns, (c) and (d) scanning electron microscope pictures of the mask patterns



EUVL mask fabrication process development

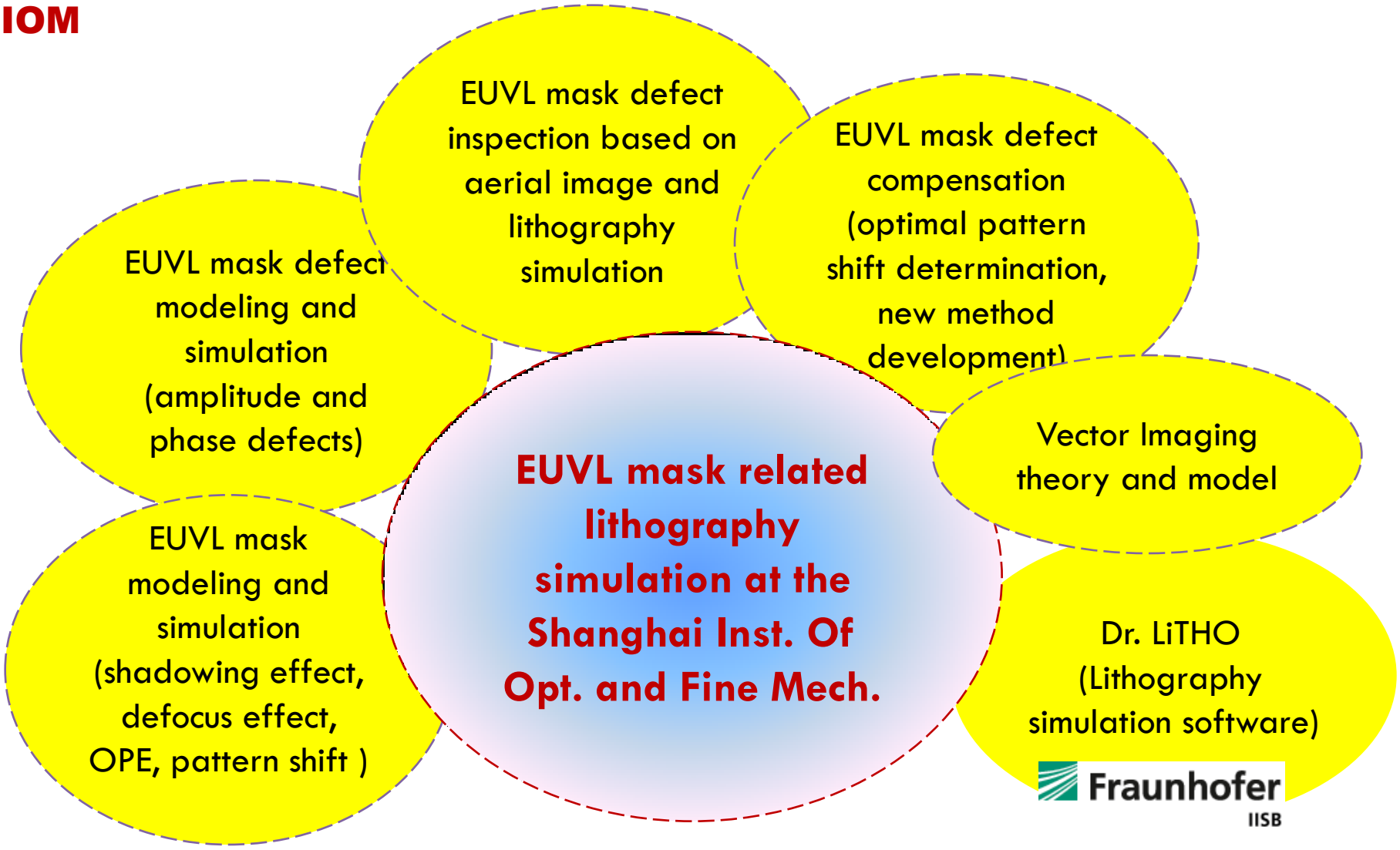


Layout of 6 inch EUVL mask

Ref: ACTA OPTICA SINICA, 33(10),1034002,(2013).

MASK

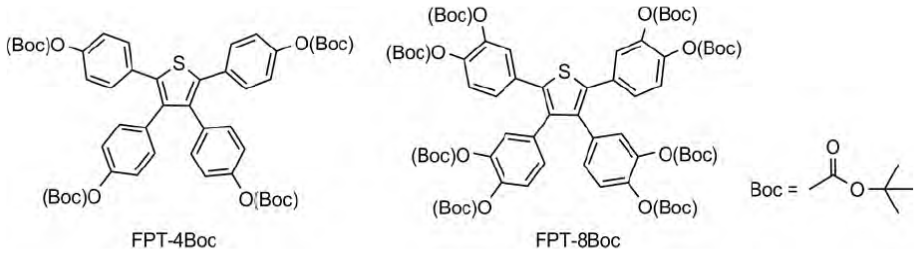
SIOM



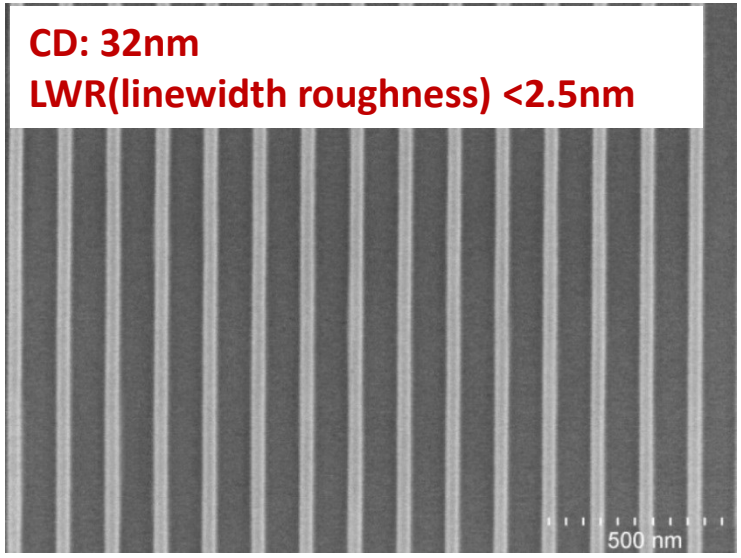
Refs: ACTA OPTICA SINICA, 35(6), 0622005 (2015); ACTA OPTICA SINICA, 35(8), (2015, to be published); J. Micro/Nanolith. MEMS MOEMS, 13(3), 033007 (2014); Proc. SPIE, 9048, 90483E (2014); ACTA OPTICA SINICA, 34(9), 0905002 (2014); J. Vac. Sci. Technol. B, 30(3), 031602 (2012); ACTA OPTICA SINICA,32(7)0705001(2012); ACTA OPTICA SINICA,32(8)0805001(2012); Proc. SPIE 8171, 81710N (2011); ACTA OPTICA SINICA, 31(4) 0405001 (2011); PRC Patents, 201310102557.1, 201310534000.5, 201410444013.8, 201510068050.8.

RESIST

Inst. Of Chem. Of CAS.



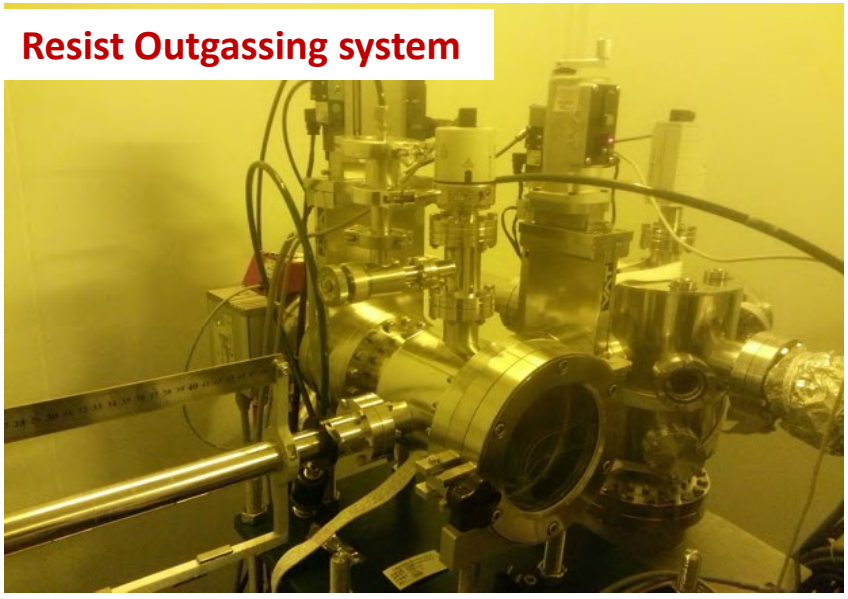
New photoresist materials development

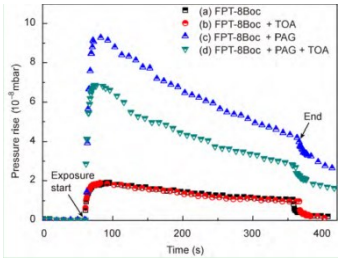


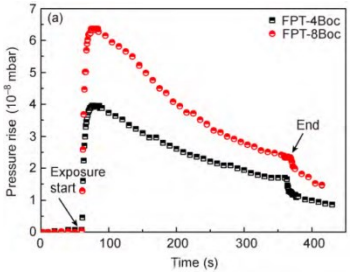
SEM pattern, photoresist FPT-8Boc+PAG(5wt% of FPT-8Boc)+TOA(10wt% of PAG)

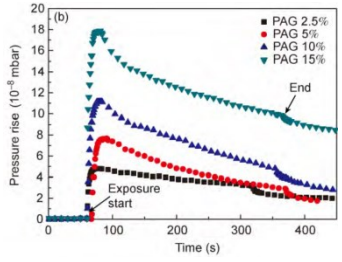
Ref: SCIENCE CHINA Chemistry, 57(12),1746,(2014).
PRC Patents : 201210113099.7, 201210070713.6.

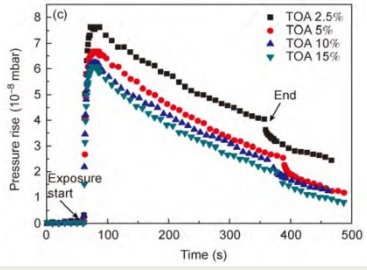
Resist Outgassing system











Investigation of outgassing of EUV resist (pressure, different components, different concentrations, species)

- Projection Optics
  - Imaging System
  - Surface Testing
  - Optical Machining
  - ML Coating
  - Aberration Metrology
- Stage
- Source
- Mask
- Resist

CONTENT

Thank you for your attention!

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