

9th EUV-FEL Workshop



Report of Contributions

Contribution ID: 1

Type: **not specified**

Opening Remarks

Tuesday, 4 February 2025 13:00 (10 minutes)

Presenter: MICHIZONO (KEK, EXECUTIVE DIRECTOR), Prof. Shinichiro

Contribution ID: 2

Type: **not specified**

Greeting

Tuesday, 4 February 2025 13:10 (5 minutes)

Presenter: MURAMATSU (MEXT), Dr. Tetsuyuki

Contribution ID: 3

Type: **not specified**

Target of the workshop

Tuesday, 4 February 2025 13:15 (10 minutes)

Presenter: KAWATA (KEK_SECRETARY OF THE WORKSHOP), Prof. Hiroshi

Contribution ID: 4

Type: **not specified**

[Key-note Lecture] EUV Lithography: Current Research and Perspective

Tuesday, 4 February 2025 13:25 (40 minutes)

With high-NA EUV Lithography entering its industrial R&D phase at various pilot lines this year, there are still a number of significant technical and scientific challenges to be addressed to ensure its success in manufacturing. I will describe some of these challenges, such as the tradeoffs between sensitivity, resolution and LER for patterning materials, as well as that of the mask 3D effects. Looking forward, there appears to be a continued need to support further 2D scaling for leading-edge devices. I will provide a perspective on the potential solutions for extending EUV lithography toward such a goal. In particular, I will give an update on the initial Hyper-NA R&D effort and the possibilities of using shorter actinic wavelengths (e.g., 'Beyond EUV' or BEUV), with a particular emphasis on the research needed for patterning materials, sources, optics and masks.

Presenter: LA FONTAINE (DIRECTOR, THE CENTER FOR X-RAY OPTICS (CXRO) , LBNL), Dr. Bruno

Contribution ID: 5

Type: **not specified**

R&D Status on Two-mirror In-Line Projector for OIST EUV lithography

Tuesday, 4 February 2025 14:25 (30 minutes)

At OIST, we have started R&D on a highly energy-efficient two-mirror in-line projector with a simplified illumination system. The EUV source power can be reduced by 1/10 compared to the current six mirror EUV projector system. The required EUV power is 20 watts for a process speed of more than 100 wafers per hour. The proposed projector achieves 0.3 NA (13 mm field) and can be mounted in a cylindrical tube configuration similar to a DUV projector, providing superior mechanical stability, easier assembly/maintenance and low cost.

The EUV light is directed in front of the mask by two narrow cylindrical mirrors on either side of the diffraction cone, called the dual line field, which provides average normal illumination and reduces the mask 3D effect. The theoretical resolution limit is 16 nm (0.3 NA), image reduction factor x4 and object image distance (OID) 1500 mm.

Presenter: SHINTAKE (OIST), Prof. Tsumoru

Contribution ID: 6

Type: **not specified**

The Must Light Source

Tuesday, 4 February 2025 14:55 (30 minutes)

Energy-Recovery Linac (ERL) based Free-Electron Laser (FEL) has been a promising solution for the high-power EUV light source for future semiconductor lithography. Considering the increasing demands of semiconductors and the roadmap for smaller nodes, realization of a higher power EUV (and BEUV) light source at high efficiency has been strongly required. At KEK, we have been designing ERL-EUV-FEL based on our experience of construction and operation of a test ERL accelerator. We will present the design of the accelerator system and its expected performance from the basic principle. It will explain the technical key items in the accelerator development planned in next 5 years.

Presenter: HONDA (ACCELERATOR LABORATORY, KEK), Prof. Yosuke

Contribution ID: 7

Type: **not specified**

Development of EUV / DUV Source for Semiconductor Manufacturing and its Application

Tuesday, 4 February 2025 15:45 (30 minutes)

In this conference, we will report about new EUV research activities in Kyushu-Univ. in Japan.

1st topic is new EUV exposure research center: named "EUV Photon Co.. This organization will support material development of material industry of EUV lithography, for example photo-resist, and photo mask and so on. We prepare EUV light source and exposure optical system and vacuum chamber system for this exposure. In this presentation we will report latest preparation of this organization.

2nd topic is new high power EUV source research program which has been preparing in Kyushu-University. Since 2003 we corroborate EUV source research with Gigaphoton. We are pioneer of combination of pulsed CO₂ laser and Sn droplets, dual wavelength pico second laser pulses for shooting and debris mitigation by magnetic field have been applied We have demonstrated high average power >300W EUV power with CO₂ laser more than 27kW at output power in cooperation with Gigaphoton and Mitsubishi Electric up to now 2). Also we are thinking about the Sn plasma dynamics which dominate the EUV emission by using Thomson Scattering (TS) measurement. Last year our group announced possibility of 10% conversion efficiency with simulation and experiment (fig.3)3). These results mention that there is still sufficient potential to increase EUV output power and conversion efficiency in near future

At the conference, we will report latest update of above two topics.

Presenter: MIZOGUCHI (QPTRC, KYUSHU UNIVERSITY), Prof. Hakaru

Contribution ID: 8

Type: **not specified**

Closing address

Tuesday, 4 February 2025 16:15 (5 minutes)

Presenter: ISHIHARA (REPRESENTATIVE OF EUV-FEL LIGHT SOURCE STUDY GROUP FOR INDUSTRIALIZATION), Prof. Sunao

Contribution ID: 9

Type: **not specified**

Photo-session

Tuesday, 4 February 2025 16:20 (5 minutes)

Presenter: -, -