

XOPT

Monday, 19 April

[XOPT-1-01] 9:30-9:40

Opening Remarks

Chair: Tetsuya Ishikawa
RIKEN Spring-8 Center

[XOPT-2] 9:40-10:40
Advances in X-ray mirror

Chair: Takashi Kimura
The University of Tokyo

XOPT-2-01 9:40 *Invited*

Advanced X-ray optics and metrology development at NSLS-II

Mourad Idrir, Lei Huang, Tianyi Wang
BNL/NSLS-II

During this talk, we will present our recent work on our newly established stitching interferometry platform, and our upgraded Nano Surface Profiler (NSP) for synchrotron mirror metrology. Thanks to these new metrology capabilities, we have developed our in house Ion Beam Figuring deterministic polishing system. Some new achieved results will be shown during the talk.

XOPT-2-02 10:10 *Invited*

Development of sub-micron soft x-ray free-electron laser focusing system at SACL

Hiroto Motoyama
The University of Tokyo

Ellipsoidal mirrors are promising optics for focusing soft x-rays down to sub-micrometre size without chromatic aberration. A soft x-ray focusing system combining an ellipsoidal mirror and a K-B mirror was developed at SACL. The focused beam size is 500 x 550 nm with a maximum peak intensity of $\sim 10^{16}$ W/cm² at the photon energy of 100 eV. The microscopic properties of materials having absorption edges in the soft x-ray region will be investigated with the system.

[XOPT-3] 11:00-12:00
X-ray optics

Chair: Taïto Osaka
RIKEN Spring-8 Center

XOPT-3-01 11:00

Wave-optical simulation for soft X-ray focusing optics using coherent mode decomposition

Yoko Takeo^{1,2}, Takashi Tanaka³, Yasunori Senba^{2,3}, Haruhiko Ohashi^{2,3}, Hidekazu Mimura¹

¹The University of Tokyo, ²Japan Synchrotron Radiation Research Institute (JASRI), ³RIKEN Spring-8 Center (RSC)

Spatial and temporal coherence of the soft X-ray focusing beam was estimated using wave-optical calculation with coherent mode decomposition. Quality of reconstructed images in ptychography measurement was compared between simulation and experimental results.

XOPT-3-02 11:15

Processing a micro-channel-cut crystal monochromator using Ni wire for reflection self-seeded X-ray free-electron laser

Shotaro Matsumura¹, Shota Nakano¹, Yasuhisa Sano¹, Taïto Osaka^{1,2}, Ichiro Inoue², Makina Yabashi², Kazuto Yamauchi¹

¹Osaka University, ²RIKEN Spring-8 Center

A high-quality channel-cut crystal monochromator with a gap width of ~ 100 μ m is indispensable for reflection self-seeded X-ray free-electron laser. We report the details about instrument and results of processing the crystal.

XOPT-3-03 11:30

Optimization of mirror deformation method for hybrid bender combining mechanical and piezoelectric bending

Yuka Nishioka¹, Takato Inoue¹, Satoshi Matsuyama², Junki Sonoyama³, Kazuteru Akiyama², Hiroki Nakamori¹, Yasuhisa Sano¹, Yoshiaki Kohmura², Makina Yabashi², Tetsuya Ishikawa⁵, Kazuto Yamauchi¹

¹Osaka University, ²Nagoya University, ³TOYAMA, ⁴JTEC Corporation, ⁵RIKEN/Spring-8

We will discuss the optimal deformation method for the hybrid bender combining mechanical and piezoelectric bending and the achievable accuracy of this method.

XOPT-3-04 11:45

Development of sub-5 nm focusing system based on precise deformable mirrors

Takato Inoue¹, Satoshi Matsuyama^{1,2}, Yuto Tanaka¹, Kohei Futamura¹, Yoshio Ichii², Jumpei Yamada⁴, Yasuhisa Sano¹, Yoshiaki Kohmura², Makina Yabashi^{4,5}, Tetsuya Ishikawa³, Kazuto Yamauchi¹

¹Osaka University, ²Nagoya University, ³JTEC Corporation, ⁴RIKEN Spring-8 Center, ⁵Japan Synchrotron Radiation Research Institute

To focus X-ray down to sub-5 nm, shape error on mirrors should be less than 0.6 nm PV. We installed a deformable mirror. In FEM simulation, the mirror could correct a shape error produced by fabrication processes.

[XOPT-4] 13:00-14:00
Wavefront / Imaging

Chair: Hiroto Motoyama
The University of Tokyo

XOPT-4-01 13:00

Single-grating interferometer for hard X-ray sub-10nm focusing mirror system

Jumpei Yamada¹, Satoshi Matsuyama², Nami Nakamura², Takato Inoue², Taïto Osaka¹, Ichiro Inoue¹, Hirokatsu Yumoto⁴, Takashi Koyama⁴, Haruhiko Ohashi⁴, Kazuto Yamauchi³, Makina Yabashi¹

¹RIKEN Spring-8 Center, ²Nagoya University, ³Osaka University, ⁴JASRI

X-ray single-grating interferometry was applied to conduct accurate wavefront corrections for hard X-ray nanofocusing mirrors. Systematic errors in the interferometer were carefully examined, and the mirror shapes were directly corrected using a differential deposition technique based on the measured wavefront errors.

XOPT-4-02 13:15

Development of wavefront sensing in full-field X-ray microscopy

Yuto Tanaka¹, Satoshi Matsuyama^{1,2}, Takato Inoue¹, Nami Nakamura¹, Jumpei Yamada^{1,3}, Yoshiaki Kohmura², Makina Yabashi², Kazuhiko Omote⁴, Tetsuya Ishikawa³, Kazuto Yamauchi¹

¹Osaka University, ²Nagoya University, ³RIKEN Spring-8 Center, ⁴Rigaku Corporation

We proposed an in-situ wavefront measurement based on the intensity information near the focus. Applying this method, we were able to measure wavefront aberrations of the AKB mirrors in the magnifying geometry.

XOPT-4-03 13:30 *Invited*

Nano-scale Chemical State Visualization of Functional Materials Using Ptychography-XAFS

Nozomu Ishiguro, Yukio Takahashi
Tohoku University

Ptychography-XAFS, a combination of ptychography imaging using coherent X-rays and XAFS spectroscopy, is one of the most promising tools for visualizing not only the mesoscopic structures but also their chemical states of the non-uniform materials in nano-scale. Here, we report demonstrations of nano-scale chemical state visualization of practical functional materials using ptychography-XAFS measurements.

[XOPT-5] 14:10-15:10
Application / Detectors

Chair: Satoshi Matsuyama
Nagoya University

XOPT-5-01 14:10 *Invited*

Feasibility study on 3D dynamic X-ray elastography for soft tissue and soft materials

Chika Kamezawa¹, Liang Xiaoyu², Tetsuro Shirasawa³, Akio Yoneyama⁴, Kentaro Kajiwara², Kazuyuki Hyodo¹, Wataru Yashiro²

¹Photon Factory, Institute of Materials Structure Science/ KEK, ²Institute of Multidisciplinary Research for Advanced Materials (IMRAM), Tohoku University, ³National Metrology Institute of Japan (NMIJ), National Institute of Advanced Industrial Science and Technology (AIST), ⁴SAGA Light Source, ⁵Japan Synchrotron Radiation Research Institute (JASRI)

We are developing dynamic x-ray elastography for soft tissue and soft materials. We show preliminary results of three-dimensional maps of storage and loss moduli using white synchrotron x-rays and high speed x-ray camera.

XOPT-5-02 14:30 *Invited*

Additional Manufacturing for X-ray optical applications

Adam Kubec¹, Frank Seiboth², Mikhail Lyubomirskiy², Frieder Koch¹, Andreas Schropp², Christian David¹, Christian Schroer^{2,3}

¹Paul Scherrer Institut, ²DESY, ³Universität Hamburg

3D-printing allows making various kinds of X-ray optical components. Structures can be made to focus beams, correct for phase existing optics or adding custom phase modifications such as a topological charge, or act as samples.

XOPT-5-03 14:50 *Invited*

CITIUS: a 17400 frames/s X-ray imaging detector with a linear response over 600 Mcps/pixel

Takaki Hatsui
RIKEN Spring-8 Center

Recent advances in photon sources deliver intense x-rays on to X-ray imaging detectors; photon counting detectors are challenged due to its limited count rate. The CITIUS detector has been developed to overcome this limitation. Experimental results will be reported with an emphasis on its high dynamic range capability, where CITIUS can detect over 600 Mcps/pixel.

[XOPT-6] 15:20-16:30
FEL-related topics

Chair: Ichiro Inoue
RIKEN Spring-8 Center

XOPT-6-01 15:20 *Invited*

Measurement of transient optical phase change as a potential diagnostics tool for extreme-ultraviolet free-electron-laser pump optical-probe experiments

Victor Tkachenko^{1,2}, Sven Toleikis³, Vladimir Lipp², Beata Ziaja⁴, Ulrich Teubner¹

¹University of Applied Sciences, Emden, Germany, ²Center for Free-Electron Laser Science CFEL, DESY, Hamburg, Germany, ³Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany, ⁴Institute of Nuclear Physics, Polish Academy of Sciences, Krakow, Poland

Transient optical properties are typical observables in extreme-ultraviolet-pump optical-probe experiments. Here we propose to additionally measure transient phase change of the optical probe pulse. Our computational study demonstrates that, at correctly tuned pulse parameters, such measurement can provide a strong enough signal enabling access to more information on transient state of the target.

XOPT-6-02 15:40 *Invited*

A diamond channel cut monochromator for operation at high energy and high repetition rate at the EuXFEL: a numerical modeling of the thermal load effects

Kelin Tasca¹, Iliia Petrov¹, Fang Yang¹, Sergey Terentyev², Maurizio Vannoni¹, Liubov Samoylova¹

¹European X-ray Free Electron Laser, ²Technol Inst Superhard & Novel Carbon Mat

A diamond channel cut monochromator for operation at high energy and high repetition rate at the EuXFEL: a numerical modeling of the thermal load effects will be presented.

XOPT-6-03 16:00 *Invited*

Hanbury Brown and Twiss Interferometry at X-ray Free-Electron Lasers

Ivan Vartianants
Deutsches Elektronen-Synchrotron DESY

The basic idea of the Hanbury Brown and Twiss (HBT) interferometry is to determine the statistical properties of radiation from the normalized second-order intensity correlation function obtained by measuring the coincident response at two detector positions. We implemented HBT interferometry at different X-ray free-electron laser (XFEL) sources from XUV to hard X-ray range. Recent results obtained at European XFEL and PAL XFEL facilities will be presented.

[XOPT-7] 16:40-17:40
Novel optics/methods

Chair: Makina Yabashi
RIKEN Spring-8 Center

XOPT-7-01 16:40 *Invited*

Thermoelastic stability of Bragg reflectors under pulsed heat load in an XFEL

Immo Bahns¹, Wolfgang Hillert², Patrick Rauer¹, Joerg Rossbach², Harald Sinn¹

¹European XFEL, ²Universität Hamburg

Thermoelastic stability of Bragg reflectors under pulsed heat load in an XFEL will be presented.

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XOPT-7-02 17:00 *Invited***Laboratory based hard X-ray microscopy with Multilayer-Laue-Lens for full-field imaging**

Juergen Gluch¹, Peter Gawlitza², Sven Niese³,
Reiner Dietsch³, Norman Huber⁴,
Ehrenfried Zschech¹

¹Fraunhofer IKTS, ²Fraunhofer IWS, ³AXO
DRESDEN GmbH, ⁴Huber Diffraktionstechnik
GmbH & Co. KG

A laboratory nano X-ray computed tomography (nano-XCT) system that is designed for the photon energy range > 10 keV and that uses multilayer optics for sample illumination and as objective lens will be presented. A multilayer Laue lens (MLL) is used for full-field imaging. We will demonstrate images of test structures acquired with MLLs at photon energies of 8 keV (Cu-K α) and 17.5 keV (Mo-K α).

XOPT-7-03 17:20 *Invited***Multi-Focus Off-Axis Zone Plates for Experiments at X-Ray Free Electron Lasers**

Florian Doering^{1,2}, Benedikt Roesner¹,
Martin Beye³, Robin Engel³, Loic Le Guyader⁴,
Andreas Scherz⁴, Manuel Langer¹,
Adam Kubec¹, Armin Kleibert¹, Joerg Raabe¹,
Carlos Vaz¹, Christian David¹

¹Paul Scherrer Institut, ²XRnanotech, ³FLASH/
DESY, ⁴European XFEL

We have designed a new type of X-ray optic that combines the beam-splitting functionality of a transmission grating with the focusing capabilities of a zone plate and hence, enables multi-focus experiments at XFELs.

[XOPT-Closing] 17:40-17:50**Closing Remarks**

Chair: Kazuto Yamauchi
Osaka University