Overview of accelerator element development in KEK for realization of EUV-FEL

Shinichiro MICHIZONO
Accelerator Laboratory, High Energy Accelerator Research Organization (KEK)

Abstract:
An energy-recovery superconducting RF accelerator called cERL is in operation at KEK. It is capable of energy conversion from high energy electrons to low energy electrons using superconducting cavities, and can produce high energy, high quality electron beams in a power efficient way. At KEK, 100% energy recovery was demonstrated in 2016, and 1 mA beam has been achieved by 2023.
The EUV-FEL utilizes this energy recovery technology to generate EUV light with an 800 MeV, 10 mA accelerator. By using an energy-recovery accelerator with superconducting cavities, a high-power electron beam can be efficiently generated, and EUV light of about 10 kW can be generated, which can operate ten 1-kW scanners. It is more power efficient than conventional LPP light sources and has the advantage of not contaminating the mirrors with debris.
The accelerator-based EUV generator can also produce shorter wavelength light by increasing the beam energy, which has the advantage of being compatible with Beyond EUV.
Several components need to be developed to create a prototype EUV-FEL using cERL technology.
- Superconducting cavity technology that operates stably in high electric gradient
- 10mA high-brightness electron gun technology
- Low-cost undulators used to generate EUV
The current baseline EUV-FEL has an accelerator size of 200 m x 20 m, but we would like to proceed in parallel with the design of an accelerator to reduce its size and the study of an amplifier mechanism for EUV light.
After about five years of development of accelerator components, we would like to construct a prototype EUV-FEL accelerator and demonstrate exposure technology using high-intensity EUV light, leading to the production of a commercial machine.

Biography:
Shinichiro Michizono received his Ph.D from the University of Tokyo in 1992. He is the professor of the accelerator laboratory in High Energy Accelerator Research Organization (KEK) and head of the Innovation Center for Applied Superconducting Accelerators (iCASA). At KEK, he has been involved in the research and development of KEKB, J-PARC, and the future large accelerator project ILC (International Linear Collider). He has been in charge of the accelerator development of the ILC, a large-scale accelerator using the superconducting rf technology, since 2015, and was appointed as the head of CASA (Center for Applied Superconducting Accelerators), which was established in 2019 to

utilize advanced accelerators such as the ILC for industrial medical applications. In 2022, iCASA was established with the goal of further technology transfer of advanced accelerators. iCASA is engaged in the research and development of the ILC, and also coordinates the research and development of EUV-FEL and other applications of superconducting rf accelerators.