Attachment 1: Technical specifications

1. The EUV light source

The EUV pulses are generated by high harmonic generation (HHG) from inert gas cells pumped by near-infrared (NIR) femtosecond pulses. The generation setup shall include the following components:

- A near-infrared femtosecond pulse amplifier. A pulse picker is preferred that supports single-shot output, and/or burst mode for a short duration of 100 μs, and/or a reduced repetition rate. The short- and long-term pointing stability of the amplifier at constant and variable environmental temperature shall be specified. The capability to change repetition rate with full average power is preferred.
- A conversion and/or pulse compression setup to keep the pulse duration below 40 fs in the NIR region. Proper diagnostic tools for the quality of NIR pulses before the HHG conversion unit should be included. The short-term power stability and long-term reliability without manual adjustment shall be specified.
- The full power of this NIR beam at <40fs should be directly available at an optional output port bypassing the EUV generation to enable optional future experiments.
- HHG generation and separation unit.
    a. The primary band of the HHG output covers 30-45 eV. Photon energy extending up to 60 eV is preferred.
    b. The total photon flux at the sample is about or over 10^{12} photons/s when focused using toroid mirror set. The total photon counts within 100 μs is about or over 10^{8}. Please specify the possible choices of separator sets and the corresponding NIR rejection ratio at the entrance of sample chamber, which is about 2000 mm away from the source. Please also include a spectrum with calibrated photon flux after the specified separator. Higher flux up to 10^{13} photons/s and 10^{9} photons within a 100 μs window is preferred.
    c. The setup shall reserve the capability to generate photons in the energy range of 60-100 eV using different gas type and/or pressure. A separate line item shall include necessary components and documentations associated with the switching procedure.
    d. The beamline shall sustain a vacuum pressure below 2e-6 mbar at the entrance of sample chamber, to avoid condensation on the cryogenic sample holder.

2. The EUV beamline, excluding the sample chamber. The sample chamber will be designed and manufactured separately. The geometry and flange will be determined later.
    - Focusing unit.
        a. Broadband demagnification focusing mirror sets with a minimum spot size smaller than 5 μm (3 μm is preferred). The mirror-to-sample distance between 100 mm to 200 mm will be determined when finalizing the design. Please provide details on the EUV focusing setup, including the design parameters of the demagnification, type of mirror combinations, mounts, layout, options for upgrades.

    b. Alignment mechanics for the mirror sets allowing adjustment in vacuum.
- If available, please include EUV imaging spectrometer with grating.
    a. The spectrograph shall reach a resolution of $\lambda/\Delta\lambda > 250$ and cover the primary band of the HHG source. The source-to-flange distance between 120 mm to 200 mm will be determined when finalizing the design.
    b. Please specify the quantum efficiency of the spectrometer for a diverging beam up to 10 mrad. Simultaneously achieving high collection efficiency and high spectral resolution is preferred, as opposed to reducing the beam divergence with entrance slit. Binning is acceptable.
    c. Positioning mechanics for the grating is preferred for online alignment to correct for sample position change within 5 mm. Please also states the spectrometer's acceptance angle to accommodate minor sample rotation.
- The light source shall reserve the capacity to perform coherent diffraction imaging, i.e. the photon flux of a single harmonic at 40 eV at the sample is about or over 10^{11} photons/s, assuming a reasonable efficiency for a focusing mirror set with multilayer coating that selects a single harmonic. Please specify the possible choices of filter sets and mirror coatings for this configuration. A separate line item shall include necessary components for a EUV beam switch towards a different end station and a reserved output port. Higher flux up to 10^{12} photons/s is preferred.

3. Synchronized light source for time-resolved spectroscopy
- Frequency converter in parallel to the EUV output
    a. Part of the NIR amplifier's power shall be converted to variable wavelength between 230-900 nm, with a minimum average power of 0.5 W at 700 nm.
    b. Optional: The capability of wavelength extensions is preferred between 900 nm to 2600 nm and between 2600 nm to 16000 nm. A separate line item may be included when available.
- A switchable NIR output for THz experiments containing two beams. One beam with pulse energy >20 μJ, duration < 40 fs, and wavelength anywhere between 1300-1500 nm. Another beam with pulse energy >5 uJ, duration < 40 fs, and wavelength anywhere between 700-900 nm. It is preferred that these two outputs can run in parallel with the time-resolved EUV spectroscopy, i.e. in addition to the EUV and the variable wavelength output mentioned above.
- Computer control hardware and software. An application programming interface (API) compatible with standard programming language such as python, C++ and MATLAB is preferred.