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Fabrication of X-Ray Gratings by Grey-Tone Electron-Beam Lithography and Thermal Oxidation of Silicon

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Diffraction gratings are an essential instrument used at free-electron laser facilities in soft and tender x-ray ranges. Their application ranges from monochromators and analyzers to self-seeding and pulse compression. These gratings are typically around 50-200 mm, up to 500mm in length with pitches from a few micrometers down to a few 100 nm, made on flat or curved substrates. Blazed gratings exhibiting higher efficiency are made by the ruling technique, however, the production of high-quality blazed gratings has become a significant bottleneck due to challenges in their fabrication and few suppliers.

In this presentation, we report on a novel method for production of next-generation X-ray diffraction gratings based on gray-tone electron-beam lithography (EBL) and thermal oxidation of silicon. We can take advantage of the greatly enhanced flexibility regarding the grating design, allowing for enhanced optical performance as well as novel optical functionalities.

This new technology will enable researchers all around the world to exploit fully the unique opportunities provided by the dramatically enhanced brilliance and coherence of a new generation of light sources.

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