Contribution ID: **131** Contribution code: **MOP24** Type: **Contributed Poster**

Optimization of Waveguide and Wire-Grid-Polarizer for Waveguide-Based Optical Resonator of Compact THz FEL

Monday 22 August 2022 17:10 (20 minutes)

At KAERI we are developing compact Terahertz(THz) Free Electron Laser(FEL) for a commercial application like security inspection. We are using a waveguide-based optical resonator for our FEL system. Firstly, we report on the selection of low loss and small cross-section waveguide candidate to enhance the gain of THz FEL. We performed a detailed analysis of waveguides with different shapes and size via COMSOL Multiphysics simulation. Based on the simulation result, we found that a waveguide with a special eye-shaped cross-section has a very small cross-sectional area of 4 mm^2 at full width at half maximum (FWHM) and a very low wave loss of less than 2.5% for 1-m propagation at an operating wavelength of 300–600 μm.
Secondly, we accomplished the optimization of the Wire-Grid-Polarizer (WGP) design parameter via COMSOL Multiphysics code, we calculated the optimized values of grating length and grating period of the WGP i.e., 20 μm and 100 μm, which have less than 10% of loss for the wavelength of 300–600 μm. The material which we used for WGP simulation is Tungsten coated with gold because it has a high extinction ratio and transmission as compared with common grating material.

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Session Classification: Monday posters

Track Classification: FEL oscillators & IR-FEL