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

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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 mm² 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 μ m.

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 μ m and 100 μ m, which have less than 10% of loss for the wavelength of 300–600 μ m. 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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