Silicon Diffractive Optics for THz Laser Radiation

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The emergence of coherent, high power sources of THz radiation [1] has formed a need for optical elements to control this radiation. Optical elements for terahertz waves are rather different comparing to the classical optical elements. For the case of high power radiation, which damage conventional plastic lenses such as polypropylene or TPX ones, silicon diffractive optical elements (DOEs) become the most beneficial for beam manipulation [2-4]. Binary silicon diffractive optical elements (diffractive lenses and beam-splitters) for manipulation by terahertz Novosibirsk Free Electron Laser (NovoFEL) radiation have been considered in before [2]. Such applications like imaging, material ablation, generation of continuous optical discharge, and even more exotic for the terahertz range application, namely the field ionization of individual atoms, require focusing of THz radiation, often with an enhanced focal depth [3]. Using binary silicon phase spiral axicons [4], non-diffractive Bessel beams with angular orbital momentum (vortex beams) with different topological charges were formed. Such beams have great potential for use in data transmission and remote sensing.

The present work is devoted to investigation of silicon power optics of terahertz range. The computational as well as experimental results are presented.

The research was performed at workstations of the Novosibirsk free electron laser [1] user facility. A high power radiation (in a routine regime, the average power is 50-150 W), a relatively narrow linewidth and the tunability of the radiation enable performing a wide variety of experiments.

The perspectives of silicon diffractive optics for terahertz range are discussed.

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