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THz optics – achievements, challenges, and prospects

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Terahertz radiation lies at the boundary of two different domains—optics and electronics. This, still not fully explored, area entwines physical phenomena describing two permeating worlds and interfering laws of optics and electronics. The fusion of two superposing physical worlds becomes an enormous challenge in designing optical elements.

All types of optical structures have been implemented for the THz waves, starting from reflective optics, going through refractive and diffractive optics, and ending on metamaterials. They all require different designing methods, manufacturing technologies and materials, and verification setups. Applicability of particular types of THz optics also strongly depends on the frequency spectrum, expected efficiency, working conditions, complexity, and price. All of these must be considered when dedicated optical elements are designed.

This work presents a variety of terahertz optical elements designed by our team. They include a variety of types, design methods (theoretical equations, backward propagation, iterative algorithms), design wavelengths (from sub-THz band to single terahertz), and applications (medical diagnostics, imaging, telecommunication). However, all these elements have one thing in common – they are dedicated to particular setups and applications, always ensuring optimized and the best possible performance in given conditions.

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