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Achievements, challenges, and prospects for THz optical systems.

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In recent years, the increased research has been conducted in the field of terahertz (THz) optics and imaging. The description that explores the landscape of THz optics, focusing on its achievements, current challenges, and prospects is given in this work. THz radiation, characterized by wavelengths considerably longer than visible light, induces substantial diffraction effects, profoundly impacting its behavior and imaging capabilities with optical elements. Moreover, the high coherence exhibited by various THz sources facilitates precise wave manipulation. However, it also introduces unwanted interference effects, which are challenging to suppress. Moreover, in many cases, THz optical systems operate within the near-field diffraction zone, which has its peculiarities.

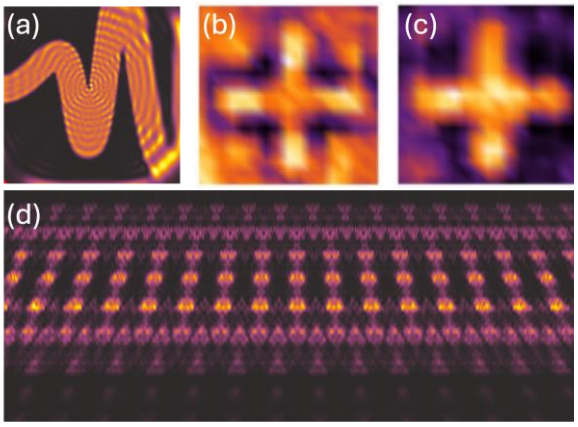

Fig. 1 Various THz intensity distributions. (a) Diffraction effects introduced by the aperture. (b) and (c) Image recorded without and with spatial filtering. (d) Talbot carpet as an example of complicated radiation pattern.

The advancement of THz optics is closely related to exploring various materials and manufacturing techniques. Different materials, ranging from dielectrics to semiconductors, exhibit excellent optical properties in the THz range. Furthermore, innovative manufacturing methods such as lithography, additive manufacturing, and metamaterial engineering play crucial roles in developing novel THz optics. In research focusing on the features of THz optical setups, attention should be directed to the aspects less dominant in visible and infrared radiation ranges. These include strong diffraction effects (Fig. 1a), unwanted interferences in imaging (Fig. 1b and c) and the relatively long wavelength in relation to the aperture size and propagation distance resulting in phenomena characteristic to near-field diffraction zone (Fig. 1d).

This presentation highlights various achievements, current challenges, and promising avenues in the field of THz optics. Emphasizing its versatile applications and the role of material science and manufacturing innovation underscores the transformative potential of THz technology in shaping future advancements.

REFERENCES

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