Terahercinė vaizdinimo sistema, pagrįsta spinduliuotės pluoštelio formavimo metodais

Terahertz imaging systems based on beam engineering methods

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Miniaturization of terahertz (THz) imaging systems is a key-factor for increasing applicability in mobile unattended package inspection systems in airports or public places [1]. Practical potential of THz imaging systems for non-destructive testing encourages a search for a compact and practically convenient solutions. One of the important issues is assumed to the development of compact diffractive optics for the THz frequency range in order to boost an evaluation of practical hand-held terahertz imaging systems applications in real time. However, real objects under test, usually, are very different and can exhibit either strong or weak absorption. It raises excessive requirements for both sensing and measurement arrangements aiming to record qualitative image. The solution should be complex by combining components miniaturization effect with selective imaging methods.

In a given communication, the innovative THz beam forming, spatial filtering and terahertz digital holography techniques are discussed. The compact diffractive optics solutions for THz beam formation starting from high efficiency compact multilevel silicon phase Fresnel lenses [2], graphite based flexible lenses [3], Fibonacci [4] or Bessel diffractive elements for thick object inspection [5] are applied. Moreover, approach of advanced Airy beam-based phase elements for imaging objects under the obstacle are presented. Focusing performance of these elements are investigated both, theoretically and experimentally. Particular attention is directed to low absorbing objects imaging due to a poor signal-to-noise ratio and small contrast. To tackle these problems, routes of using spatial filtering methods like phase contrast or dark field spatial filtering can induce additional useful information to discriminate transparent objects. The principal experimental scheme of the THz imaging setup is presented in Fig. 1. The proposed methods exhibit enhancement in images contrast up to 30 dB and an order of magnitude increased signal-to-noise ratio [6].

Finally, advantages of the digital holographic technique will be presented by comparing the results with data of weak absorbing objects obtained via point-to-point, plane-to-plane (4 f setup) and the dark-field THz imaging approaches. Presented imaging techniques will impact wider THz implementation in practical applications, where weak absorbance of THz radiation in many cases is inherent feature of objects under test.

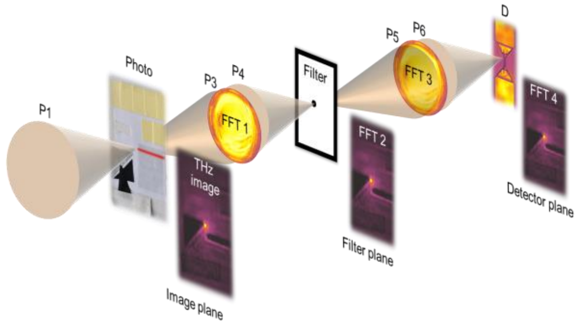

Fig. 1. An innovative terahertz imaging system based on compact diffractive optics and special filtering methods, where P - corresponds to focusing element.

Keywords: THz beam forming, spatial filtering, digital holography, Fibonacci, Bessel, diffractive element.

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