

Compound Eye Like Diffractive Optics for sub-THz camera

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The necessity of fast and efficient detection of THz radiation at room temperature is crucial in many applications concerning the fields such as medicine, security, quality inspection, aviation, military and many others. For selected application the critical parameter is spatial resolution in the captured image. For another group of applications critical parameters are extremely fast response and very wide angle of incidence. This last idea is realised in practise basing on the fast THz camera and sophisticated diffractive optics.

The Orteh Company designed and manufactured the standard matrix of 8x8 detectors based on field-effect transistors (FETs) with signal processed by fast FPGA circuits. The typical multiplexing technique is replaced by a parallel pixel processing. This innovative solution enables utilization of the separate lock-in for each pixel to enlarge the dynamics and sensitivity for the registered signal. For the static mode mentioned solution provides extremely fast image acquisition.

Additionally, we have designed dedicated matrix of lenses that focuses the incoming radiation on each detector and therefore strengthens the registered signal around 10 times [1]. Additionally matrix of lenses can significantly decrease an optical crosstalk. Such a matrix of lenses was designed for 0.3 THz and manufactured using 3D printing technique SLS (Selective Laser Sintering), which assures low attenuation and good physical parameters of the element.

Here, we would like to present a new type of the structure working together with THz Orteh camera – called a fly's eye (sometimes also moth's eye). This type of the structure was designed and dedicated for particular geometry of the designed matrix and allows for detection of THz radiation from much wider angle of incidence.

Fly's eye-like diffractive structure together with THz camera with parallel processing provide features typical for insect vision – almost 180 deg. field of view and extremely fast response.

References

[1] Szkudlarek K., et. al. "Terahertz 3D printed diffractive lens matrices for field-effect transistor detector focal plane arrays", *Optics Express*, Optical Society American, vol. 24, nr 18, 2016, ss. 20119-20131