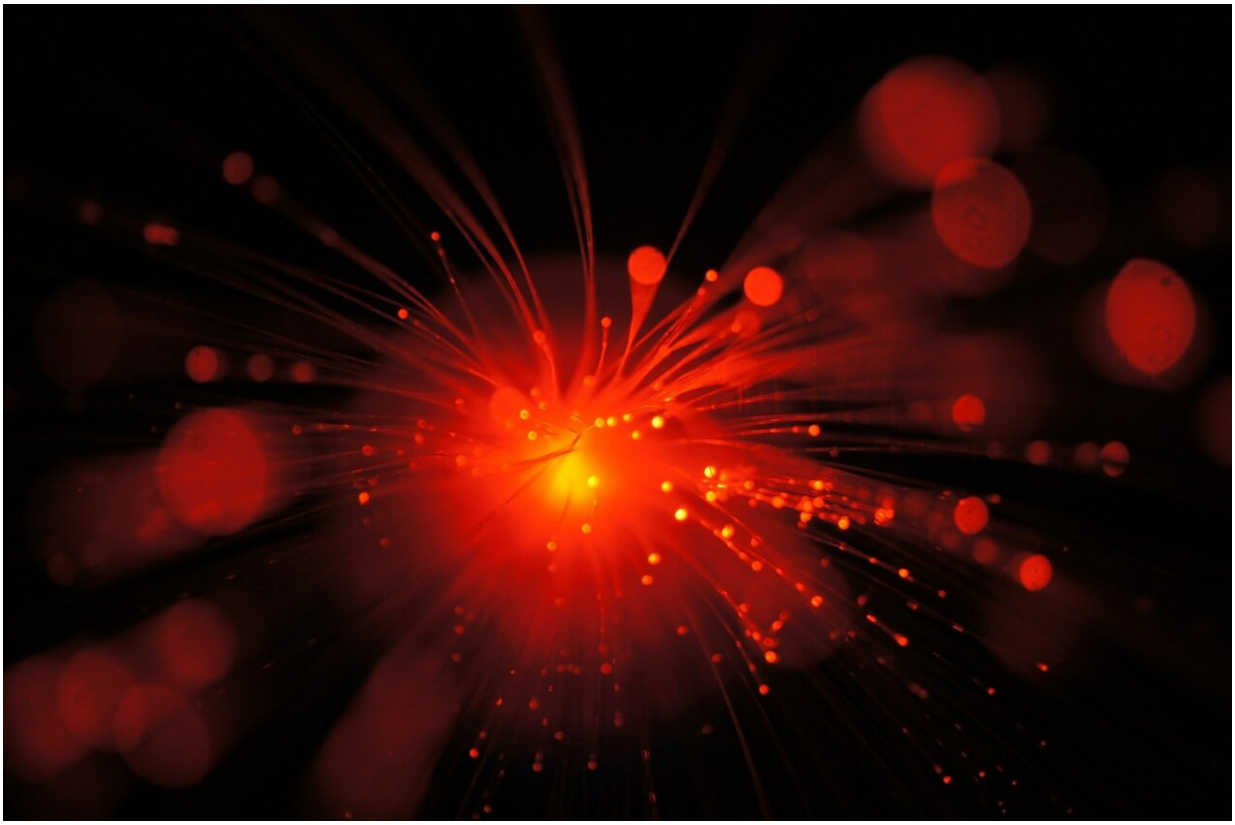
A simple method to enhance responsivity of terahertz radiation detectors

June 24 2021



Credit: CC0 Public Domain

Scientists of Tomsk Polytechnic University jointly with colleagues from Spanish universities have offered a simple method how to enhance the responsivity of terahertz radiation detectors by 3.5 times using a small

Teflon cube. The 1 mm cube must be put on the surface of the detector without changing the inner design of the detector.

Such detectors are applied in full-body scanners, spectrometers, and medical devices for diagnosing skin cancer, burn injuries and pathological changes in the blood. The research findings were published in the *Optics Letters*.

The terahertz range lies between the microwave and infrared ranges in the electromagnetic spectrum. Waves shorter than 1 mm propagate in the terahertz range. They are able to percolate various materials while not leading to atomic ionization of matter, unlike X-rays.

"Terahertz radiation detectors are, as a rule, rather compact devices. Nowadays, researchers from different countries are interested in the enhancement of their responsivity and other parameters. The higher responsivity, the weaker signals can be received and more precise measurements can be carried out. Most researchers are trying to solve this problem by changing the design of the detector and the materials it is made from. It is complicated and often very expensive. Meanwhile, our solution is plain to see," says Oleg Minin, Professor of the Division for Electronic Engineering of the TPU School of Non-Destructive Testing.

In their experiments, the scientists used a microparticle in the form of the Teflon cube, an available dielectric material through which electromagnetic waves of the terahertz range are capable of percolating. The cube was put on the surface of the detector.

"There is a responsive site inside of the detector. The site can be made from various materials but its typical scale is always less than the wavelength. It is the area responsible for trapping electromagnetic waves and transferring them. Due to the form and material, our cube possesses

a capability to focalize radiation well, falling on the responsive site of the detector, in the scale limited to or smaller than a diffraction-limited system. The experiments conducted jointly with the Spanish colleagues proved it: the particle focalized the radiation and the emitted radiation fell into the responsive area," Oleg Minin explains.

According to the scientists, the developed method of detector responsivity enhancement without changing its design is applicable to almost any detector.

During the experiments, the scientists fixed responsivity enhancement by 11 decibels, which is 3.5 times higher than the standard parameters of the detector.

More information: Igor Vladilenovich Minin et al, Responsivity enhancement of a strained silicon field-effect transistor detector at 03 THz using the terajet effect, *Optics Letters* (2021). DOI: 10.1364/OL.431175

Provided by Tomsk Polytechnic University