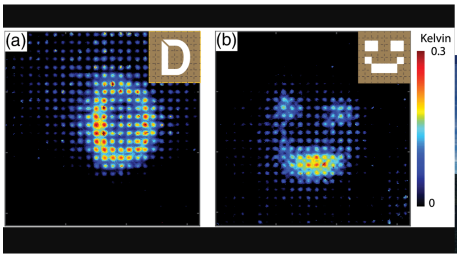

All dielectric absorber for improved real-time imaging in the terahertz spectrum

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Publication(s)

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External Link(s)

• From the lab of Dr. Willlie Padilla
• Absorbing Electromagnetic Energy While Avoiding the Heat (Duke Pratt School of Engineering, 2017)

Value Proposition

Discoveries over the past decades have unveiled unique characteristics of the far-infrared or terahertz (THz) spectrum spanning from 0.3 THz to 10 THz, including non-ionization of biological materials, easy penetration into dielectric and non-polarized objects, and spectral fingerprints of most materials and molecules. These characteristics present great promise for terahertz imaging and detection. Practical applications include screening for skin cancer, concealed weapons detection, and identification of hazardous substances at a standoff. Conventional uncooled terahertz imaging using timedomain spectrometer provides high signaltonoise ratio but requires acquisition time too long to perform realtime imaging. Although there have been many developments on semiconductor based focalplane arrays and uncooled infrared microbolometric arrays, the limitations on the semiconductor materials and lower absorption efficiency of infrared arrays curb the applications with low cost and low complexity. There is a need for improved systems and techniques for far-infrared and terahertz imaging.

Technology

A team of Duke’s researchers have reported an imaging device using dielectric metamaterial absorbers intended to improve images collected in the terahertz spectrum. Their device utilizes all-dielectric metasurface absorbers that act as universal converters of radiation. Incident THz waves are absorbed by the metasurface, converted to heat, and subsequently detected by an infrared camera. The metasurface consisting of sub-wavelength cylindrical resonators that achieve diffraction limited imaging at THz frequencies without cooling. The low thermal conductivity and diffusivity significantly limits the thermal conduction between neighboring pixels, thus improving spatial resolution and imaging time. Experimental results showed the absorbance of the all-dielectric metasurface was as high as 96% at a frequency of 603 GHz and achieved a thermal responsivity of 2.16 x 104 K/W at a modulation speed of 1/4 Hz.

Advantages

- Real-time imaging in the millimeter-wave and terahertz ranges
- High responsivity
- Low cost
- Simpler design and configuration
- Scalable over the electromagnetic spectrum
- Does not require cooling components