QIRT 10 10th International Conference on Quantitative InfraRed Thermography
July 27-30, 2010, Québec (Canada)

Thermal converter for quantitative, 2D and 3D real-time TeraHertz imaging

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Abstract

Once the bolometer is a classical way to detect a large range of electromagnetic radiation by the thermal conversion of this incident radiation, it is here proposed to implement the classical know-how of the heat transfer community in order to design original terahertz sensors. The aim of this work is to present the recent advance in our laboratories for the measurement of terahertz radiation by using infrared temperature flux sensor. It is proposed to use the bolometer principle in order to design simple thermal converter for TeraHertz electromagnetic wavelength. The main idea is to measure the temperature increasing of a sensitive THz absorber. We demonstrate that most of these sensors are found to be efficient, sensitive and fast enough for quantitative measurement of TeraHertz source power as well as for 2D and 3D terahertz imaging. By combining optical and thermal technology, we extend and adapt the use of thermal sensor to large THz wavelength till 3 mm (0.1 THz). The large variety of thermal sensor (mono- or arrayed- sensors) will be used and optimized in order to finally present real-time room temperature THz imaging using adapted infra-red focal-plane microbolometers array (FPMA) camera. Optimisation and adaptation of such FPMA will be discussed and a new arrayed device prototype for full-field real-time THz imaging will be presented. The adaptation of FPMAs has been implemented in the THz range using a new concept: the arrayed THz-Thermal Converter, "TTC". This small size, low cost and efficient prototype design will be discussed on the thermal point of view and has been characterized using a compact powerful THz source. The TTC sensitivity has also been evaluated and the measured 2D and 3D images clearly illustrates the high potential of this new kind of THz camera.

This paper was published in the QIRT Journal 7.2