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P2.13: All-electrical control of micromechanical bolometers for THz detection

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Radiations in the terahertz and infrared spectrum have proven useful in practical applications such as security screening, medical imaging, and wireless communication [1,2,3]. Many of these applications would greatly benefit from practical and compact detectors capable of working at room temperature, capturing tens of images per second and providing a low-medium number of pixels (typically around 104 - 105 pixels). In order to fulfill all these requirements in the frequency range of 0.3-10 THz, where classic electronic devices are highly inefficient, we make use of Si3N4 micro-bolometers which shift their mechanical resonance frequency as they heat-up by absorbing terahertz radiation.
In previous works, the vibration of these devices was induced by a piezo membrane, while the resonance frequencies were determined through optical interferometry [4]. However, in our latest sensors (as shown in Figure 1), we have implemented a novel approach that greatly simplifies the excitation and measurement of the sensor's resonance frequency. Specifically, two golden stripes are integrated into the device, and under appropriate conditions, current injected through one of these stripes can vibrate the sensor, inducing a modulated current on the other strip for electrical readout, whose frequency is a function of the absorbed radiation.
In the presented work, we describe the setup used to perform a fully electrical readout of these sensors (Figure 2), which not only simplifies the measurement process but also provides a significant improvement in measurement speed and accuracy. We thoroughly discuss the first measurements obtained using this setup and compare them with both the interferometry results and our previous simulations, where we have modelled a sensor with a lumped parameter passband filter [5]. Our results demonstrate the efficacy of this approach for real-time terahertz imaging and other applications where fast and accurate measurements are critical.

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