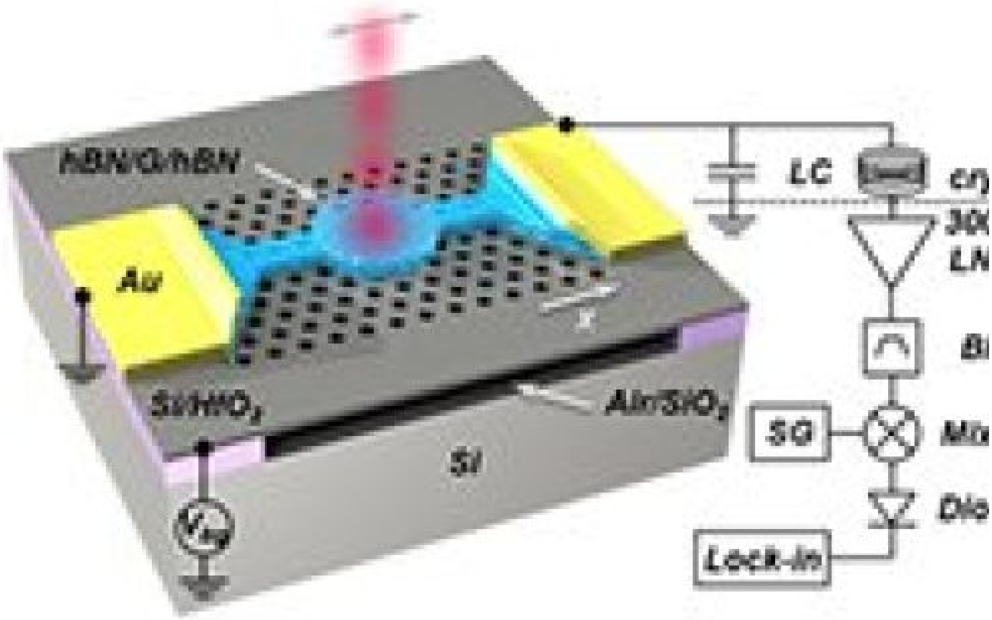

Graphene Bolometers in Nature Nanotechnology

An international study reports on the development of ultra-sensitive and ultra-fast graphene bolometers

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Bolometers are devices used for measuring the power of incident electromagnetic radiation thru the heating of materials that exhibit a temperature-electric resistance dependence. These instruments are among the most sensitive detectors so far used for long wavelength radiation and are a key technology for thermal imaging and observational astronomy.

However, even though they are considered the best detectors so far, they still present certain drawbacks, which include their very low detection bandwidths, fragile architectures and ultra-low operation temperatures.

Thus, in order to overcome these limitations, an international team of researchers has recently published a study in which they report the fabrication of a hot-electron bolometer based on graphene. Coupled to a photonic nano-cavity, the device has proven to fully operate at thermal ranges up to room temperature and have an intrinsic bandwidth which is orders of magnitude higher than current state-of-the-art bolometers. The results of the study have been published in Nature Nanotechnology.

The team of scientists, which includes ICFO researcher Dmitri Efetov, together with colleagues from MIT, Columbia University, and Raytheon BBN Technologies, has integrated graphene into the device because this material has proven to have the smallest electronic heat capacity know today and an extremely weak electron-phonon coupling. In this study, they describe the operational principle of the device, which is based on Johnson noise readout of the hot electrons in graphene and their critical light coupling to a photonic nano-cavity.

The results of this study prove that 2D materials, in particular graphene, are definitely a breakthrough in the sensing realm and could mean a shift in the paradigm of the thermal properties of bolometric materials since it has enabled for the first time the possibility of detecting high sensitivities and high bandwidths at the same time.

The realization of such unique device, with improved light absorption, high sensitivity, ultrafast thermal relaxation time and no limitations on its operating temperature, opens a new window for bolometers with entirely new functionalities that could radically improve thermal imaging, observational astronomy, quantum information, and quantum sensing, among others.