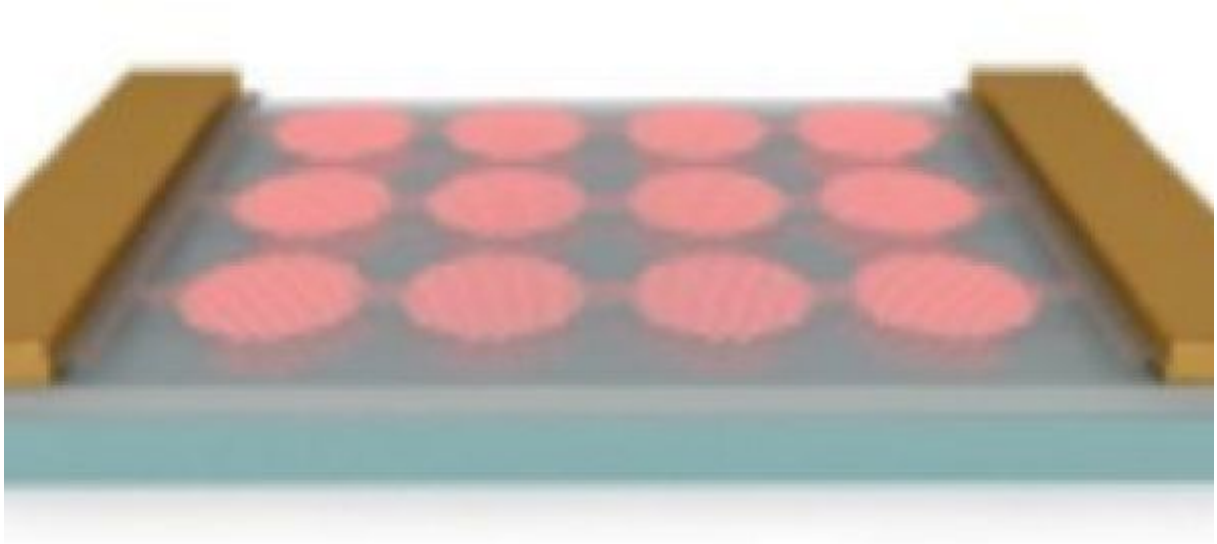


Graphene as an infrared detector

An ICFO and Yale study uses graphene to efficiently detect mid-infrared light at room temperature and convert it into electricity.

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Detecting infrared light is of major importance for current applications in spectroscopy, materials processing, chemical, bio-molecular and environmental sensing, security and industry since the mid-infrared spectral region is the range where characteristic vibrational transitions and rotational excitations of many important molecules occur.

These vibrational and rotational excitations of many molecules, including hazardous and biological molecules, have frequencies that lie precisely in the mid-infrared, which can be monitored by observing the absorption of light in this specific spectral range. However, currently available mid-infrared detectors are very inefficient, except those that can operate

at cryogenic temperatures, because they incorporate superconducting elements. Thus, this low temperature limitation is a major drawback in having detectors integrated in devices for consumer products.

Now, in a recent study published in Nature Materials, ICFO researcher Renwen Yu, led by ICREA Prof. at ICFO Javier Garcia de Abajo, in collaboration with Prof. Fengnian Xia?s group Yale University, have demonstrated that graphene can be used to fabricate very efficient mid-infrared detectors operating at room temperature.

The researchers have proposed and been able to experimentally demonstrate that the collective oscillations of charge carriers in this carbon material -known as graphene plasmons-are capable of boosting the sensitivity by making use of the resonant coupling between mid-infrared light and those plasmons.

In their study, the team of researchers fabricated a device on a CVD graphene wafer composed of graphene-disk plasmonic resonators connected by quasi-1D graphene nanoribbons. They then shined mid-infrared light (12,2 ?m wavelength) onto the setup and observed the excitation and high room-temperature absorption of IR plasmons on the surface of the graphene resonators and nanoribbons. They also observed that, thanks to the graphene nanostructures, the absorption of light that was being converted into an electrical responsivity was strongly linked to the level of the plasmonic absorption, with response times enabling detection at GHz speeds.

The results of this study prove graphene to be an excellent material for ultrafast conversion of light to electrical signals at room temperature, triggering the development of very small-sized detectors that could be easily integrated into high-resolution mid-infrared cameras or high density integrated infrared photonic circuits aimed for applications such as

security, bioassays or air quality monitoring, among others.