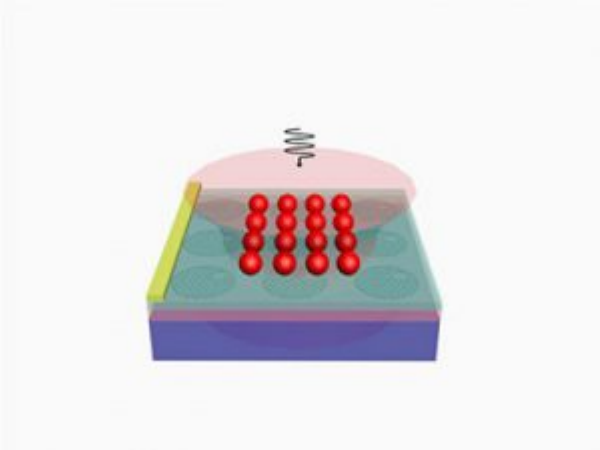
A Plasmonic Sensor Designed with Graphene

Scientists at a Chinese university have designed an infrared sensor that exploits the plasmonic properties of graphene to detect multiple wavelengths.



Exploring plasmons and graphene

Many experiments with nanoscale sensor design have explored the possibilities of surface plasmon polaritons (SPPs)—electromagnetic surface waves stimulated by light. The resonance of the surface plasmons can shift dramatically due to small changes in the refractive index of the sensing medium. SPP experiments often use noble metals as plasmonic surfaces, but these materials respond only to visible wavelengths of light. Some previous sensors designed with patterned metamaterials detect only one particular frequency that is fixed at the time the sensor is built. The team at China Jiliang University in Hangzhou turned to graphene, which interacts well with infrared light, and proposed a design that employs it as the plasmonic material atop a dielectric substrate of calcium fluoride. Using computer simulations, the scientists explored what would happen if they shaped the graphene into 40-nm-radius disks, with each disk containing a small, off-center circular defect in its crystalline

structure. An ion-gel layer on top of the graphene disks delivers a bias voltage to the setup.

Introducing defects

The presence of the defect stimulates a phenomenon called plasmon hybridization, which produces dual-band resonance peaks in the mid-infrared spectrum. Moving the location of the defects within the disks in the *x-y* plane and measuring the resulting changes in the transmission spectra shows that the array is polarization-sensitive. Scientists can change the sensitivity of the sensor to detect different substances by adjusting the applied voltage. Putting the sensor near a substance of interest changes the refractive index of the sensor, thus registering a detection.

The China Jiliang team reported that the sensitivity of their proposed design reached 550 cm^{-1} per refractive index unit. Researchers from Zhejiang University of Technology in China and the Technical University of Denmark also contributed to the study.

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