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Multimodal Graphene Biosensor

Docket # 14-6801

STATE OF DEVELOPMENT

prototype sensor

INTELLECTUAL PROPERTY

Provisional US Patent Application

REFERENCE MEDIA

Cubukcu et al. (2014). Optoelectromechanical Multimodal Biosensor with Graphene Active Region. Nano letters, 14(10), 5641-5649.

DESIRED PARTNERSHIPS

- License to technology
- Sponsored research

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Problem

Most biosensors rely on a single sensing mode to detect the presence of a molecule of interest. These single-mode sensors face a tradeoff between sensitivity (the lower detection limit) and dynamic range (the difference between the lowest and highest concentrations that the sensor can detect). Additionally, single mode sensors only record a molecule's effect on the sensing mode in question, whether that is an electrical, mechanical, or other property.

Solution

Researchers at the University of Pennsylvania have developed a new biosensor that makes use of three simultaneous sensing modes to detect molecules with much greater discrimination than existing devices. The new sensor combines a graphene field effect transistor, plasmonic nanodisk antennae, and a silicon nitride resonator in a single device, providing simultaneous electrical, optical, and mechanical sensing modes. Since no two molecules will generate the same set of electrical, mechanical, and optical responses, the discrimination provided by the multimodal sensor is much greater than the current state of the art.

The prototype device has demonstrated a dynamic range of 5 orders of magnitude of protein concentration, an improvement over single mode sensors by 2–3 orders of magnitude. The minimum detection limit is the new device is approximately 30 pM, which is comparable to existing state of the art devices.

By using the multimodal sensor, a much greater range of data can be captured that reflects the adsorption effects on the optical, mechanical, and electrical response of the sensor. The label-free operation and improved dynamic range of this device also means that a wider range of molecules and concentrations can be analyzed, all with a single device. This improved capability could provide benefits in applications ranging from point of care diagnostics, human performance monitoring, and the detection of hazardous materials.

Inventor

Ertugrul Cubukcu is an assistant professor with joint appointments at Penn's departments of Materials Science & Engineering and Electrical & Systems Engineering. His work explores light-matter interactions for novel nanoscale sensors and devices.

http://www.seas.upenn.edu/~cubukcu/Cubukcu_Lab/Home.html