Researchers create method for more sensitive electrochemical sensors

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Graphene and related materials hold promise for the future of electrochemical sensors—detectors that measure the concentration of oxygen, toxic gases, and other substances—but many applications require greater sensitivity at lower detection ranges than scientists have been able to achieve.

A Northwestern University research team and partners in India have recently developed a new method for amplifying signals in graphene oxide-based electrochemical sensors through a process called "magneto-electrochemical immunoassay." The findings could open up a new class of technologies with applications in medicine, chemistry, and engineering.

Researchers from Northwestern's McCormick School of Engineering and Applied Science, the Northwestern International Institute for Nanotechnology (IIN), the Northwestern University Atomic and Nanoscale Characterization Experimental (NUANCE) Center, and the Institute for Microbial Technology (IMTECH)-India, a national laboratory of India, contributed to the research.

A paper about the work, "Enhancing Electrochemical Detection on Graphene Oxide-CNT Nanostructured Electrodes Using Magneto-Nanobioprobes," was published November 19 in *Nature Scientific Reports*.

Graphene-based nanocomposite films have recently been used as an effective sensing platform for the development of electrochemical sensors and biosensors because of their unique facile surface modification characteristics and high charge mobility.

The researchers' new concept combines the advantages carbon nanotubes and reduced graphene oxide together with electrochemical bursting of magnetic gold nanoparticles into a large number of metal ions.

High sensitivity was achieved by precisely designing the nanohybrid and correlating the available metal ions with analyte concentration. The researchers used tiny magnetic particles encapsulated in inert coating of silicon dioxide to make core-shell nanostructures with favorable magnetic properties of metallic iron while preventing them from oxidation or significant degradation. They were then coated with gold because of its chemical inertness and biocompatibility.

This novel immune-detection platform shows potential for rapid and sensitive screening of environmental pollutants or toxins in samples. Researchers reported the ultrahigh sensitivity of this method for a new generation of herbicide diuron and its analogues up to sub-picomolar concentration in standard water samples. The process also proved to be efficient and cost-effective: tens of thousands of screen-printed electrodes can be manufactured quite readily with low cost for such hybrid assay.

Provided by Northwestern University

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