Researchers develop faster biosensor platform using a magnetic field

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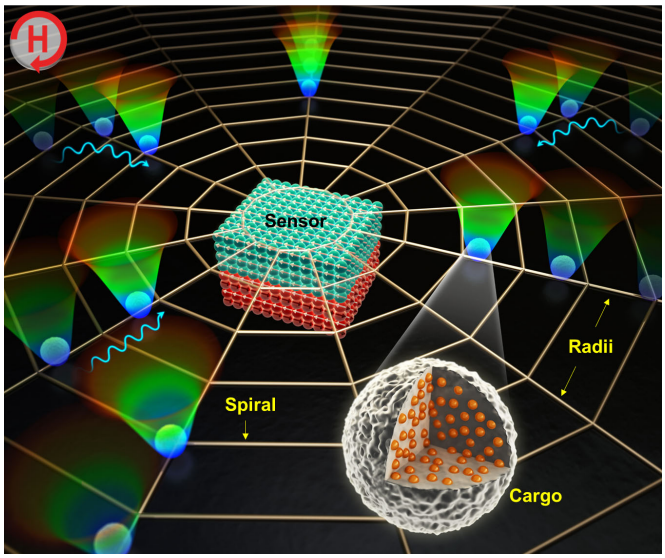
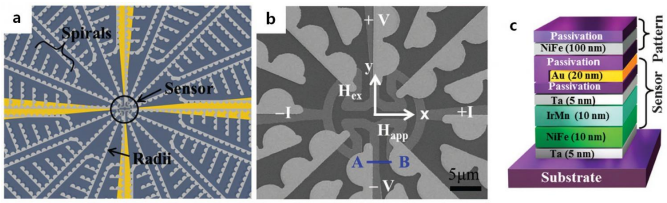


A schematic of a biosensor platform resembling a spider web. Credit: DGSIT

A research team led by Professor CheolGi Kim has developed a biosensor platform using magnetic patterns resembling a spider web with detection capability 20 times faster than existing biosensors.

The sensing capability of a biosensor is determined by the resolution of the sensor and the movement and reaction rate of molecules. Many research groups in Korea and other countries have been improving the resolution through with nanomaterials innovations, but there improving the sensitivity is challenging due to the low diffusion transport of biomolecules toward the sensing region.

Professor Kim and his research team used a magnetic field to overcome the slow movement of biomolecules such as proteins and DNA is slow when the transport depends on diffusion. Biomolecules labeled with superparamagnetic particles could be controlled with the use of an external magnetic field and detected with an ultra-sensitive magnetic sensor. The research team's biosensor platform uses a spider web-shaped micro-magnetic pattern that improves the sensing ability of the biosensor by attracting biomolecules labeled with the superparamagnetic particles to the sensing area.

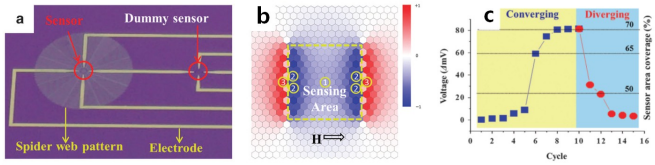


a. Schematic representation of the sensor-integrated magnetic spider web; b. Scanning electron microscope (SEM) image of the sensor integrated with the spider web net; c. Schematic cross-sectional view of the layered structures of the sensor and magnetic patterns, marked as A and B in Figure b. Credit: DGIST

The first author Byeonghwa Lim at DGIST's Ph.D program of Emerging Materials Science elaborated on the biosensor platform: "When a rotating magnetic field is applied to a spider web-shaped magnetic pattern, it can attract biomolecules labeled with superparamagnetic particles faster to the sensor. The speed is very fast and it can detect the subject 20 times faster than the diffusion method."

The research team also succeeded in monitoring the biomolecules conjugated to the superparamagnetic particles at a distance from the sensing area by utilizing the biosensor platform. In addition, the team found that the superparamagnetic particles not only play the role of biomolecular cargo for transportation, but also act as labels for the sensor to indicate the location of biomolecules.

Professor Kim said, "The existing biosensors require a long time to detect low-density biomolecules, and have poor sensing efficiency as they only depend on diffusion. The magnetic field-based biosensor platform improves the collection capability of biomolecules and increases the speed and sensitivity of the biomolecules movement. Therefore, we are planning to use this platform for early diagnosis as well as recurrence diagnosis of diseases such as cancer. "



a. A photo of the magnetic spider web chip integrated with the magnetoresistive sensor; b. Landscape of effective stray field depending on the particle location with respect to sensing area of the sensor; c. The measured sensor signal. Credit: DGIST

More information: Byeonghwa Lim et al, Concentric manipulation and monitoring of protein-loaded superparamagnetic cargo using magnetophoretic spider web, *NPG Asia Materials* (2017). DOI: 10.1038/am.2017.37

Provided by DGIST