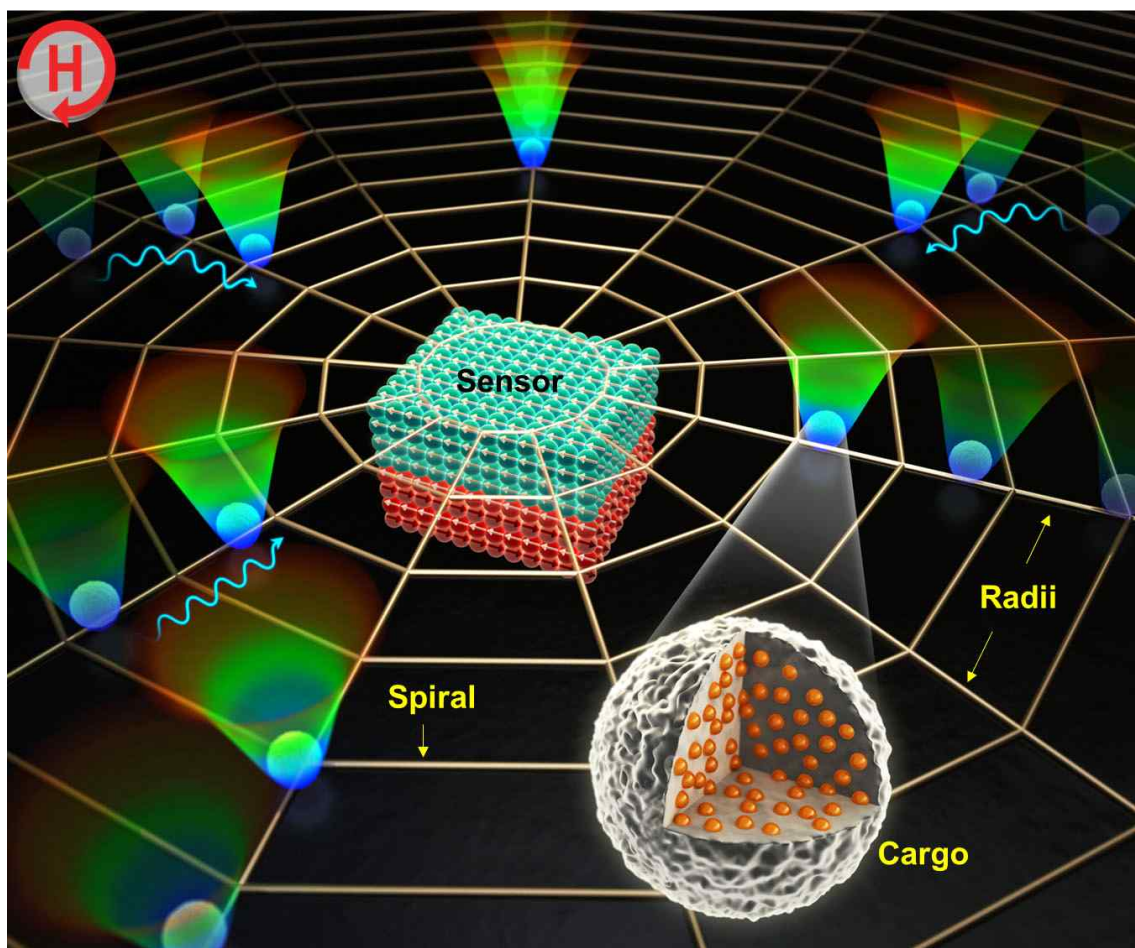
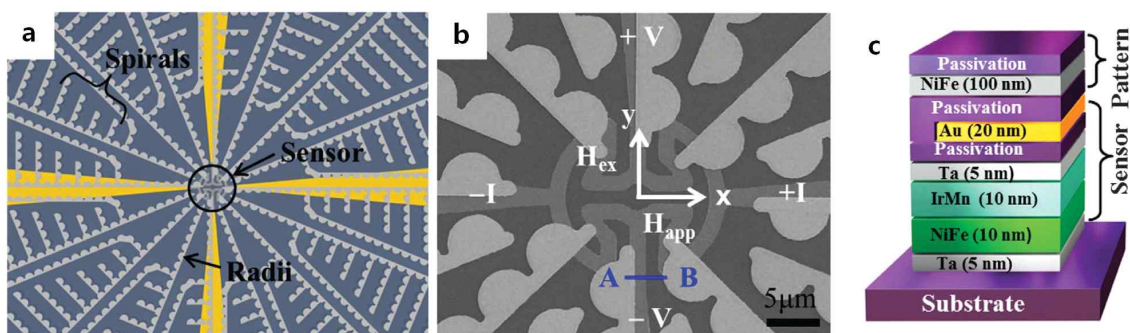


## DGIST Develops 20 Times Faster Biosensor

- DGIST's research team develops technology which is 20 times faster than the existing biosensors using micromagnetic pattern of spider web
- The technology can be used for early diagnosis and recurrence diagnosis of diseases such as cancer



[Figure 1] A schematic of a biosensor platform resembling a spider web



[Figure 2] Biosensor using Magnetophoretic Spider Web

- 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

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

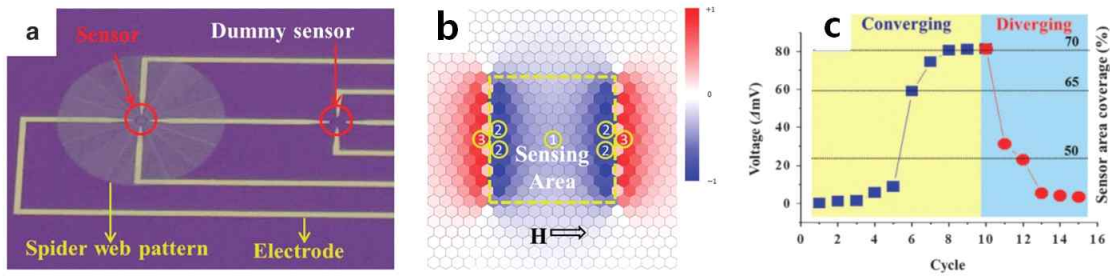
The sensing capability of a biosensor is determined by the resolution of the sensor and the movement and reaction rate of molecules. Many research groups in Korea and other countries have been improving the resolution through the development of nanomaterials but there has been a limitation to improve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

Professor Kim and his research team used a magnetic field in order to overcome the drawback that the movement of biomolecules such as proteins and DNA is slow when the transport only depends on diffusion. The biomolecules labeled with superparamagnetic particles and the use of an external magnetic field enabled the movement of the biomolecules to be easily controlled and detected with an ultra-sensitive magnetic sensor.

The research team developed a new biosensor platform using a spider web-shaped micro-magnetic pattern. It improved the sensing ability of the biosensor as it increased the ability to collect low-density biomolecules by attracting biomolecules labeled with the superparamagnetic particles to the sensing area.

The first author Byeonghwa Lim at DGIST's Ph.D program of Emerging Materials Science elaborated on the biosensor platform, "We placed a spider web-shaped micro-magnetic pattern which was designed to move the superparamagnetic particles toward the center of the biosensor and a high sensitivity biosensor on the 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 of the movement 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 has identified 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.



[Figure 3] Measuring signals using the sensor

- 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

Professor Kim stated "The existing biosensors require long time to detect low density biomolecules and result in 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. "

This study has been published online in March 31st issue of NPG Asia Materials, the sister journal of Nature, an international academic journal. The research was conducted with the support of the BioNano Health Guard Research Group and Plasma Bioscience Research Center of the Ministry of Science and ICT and Future Planning.

Journal Reference

Concentric manipulation and monitoring of protein-loaded superparamagnetic cargo using magnetophoretic spider web

**Abstract**

A lab-on-a-chip (LOC) magnetophoretic system for the remotely controllable transport of magnetic particles actuated by thin permalloy magnetic tracks has been developed as a novel architecture composed of radii and spiral tracks resembling a spider web network, where the network tracks have the asymmetric and anisotropic magnetic properties for the directional transportation of particles (cargos). A planar Hall resistance (PHR) sensor is integrated with the web networks, and the manipulation and detection are achieved via superparamagnetic particles with dual functions as a biomolecule cargo for transportation and labels for monitoring. The streptavidin protein-coated magnetic particles are precisely manipulated toward the PHR sensor surface via the radii and spiral tracks by applying an external rotating magnetic field. The stray field was analyzed in terms of the particle coverage on the sensor surface, where the sensor signal linearly varies with the number of particles on the sensor surface. This allows the effective collection of low-density biomolecule carriers to one specific point and monitors the accumulated carriers. The developed novel technology could affect multiple fields, including bioassays, cell manipulation and separation and biomechanics.

#### [DGIST Research News in Media]

- [\[ScienceDaily\] Faster biosensor for healthcare now developed](#)
- [\[Phys.org\] Researchers develop faster biosensor platform using a magnetic field](#)
- [\[CrazyEngineers\] DGIST devises a biosensor that runs 20 times faster than existing systems](#)
- [\[Science Times\] Researchers Develop Faster Biosensor Platform With Magnetic Field to Diagnose Cancer](#)

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