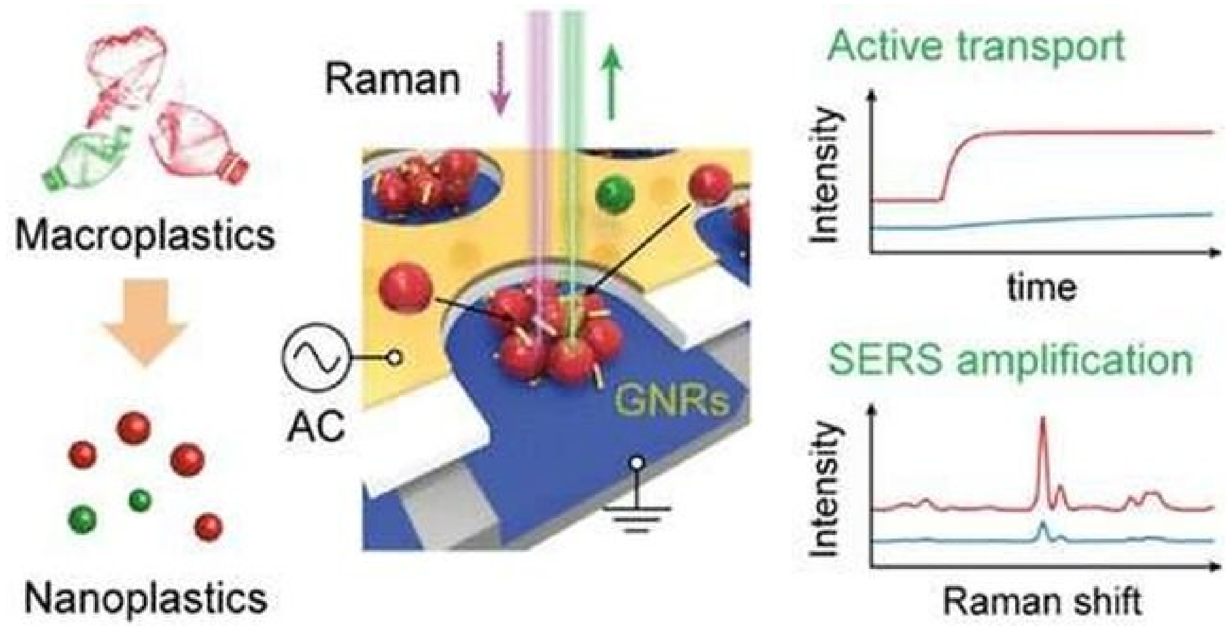
Capturing nanoplastics in tap water with light

February 27 2023



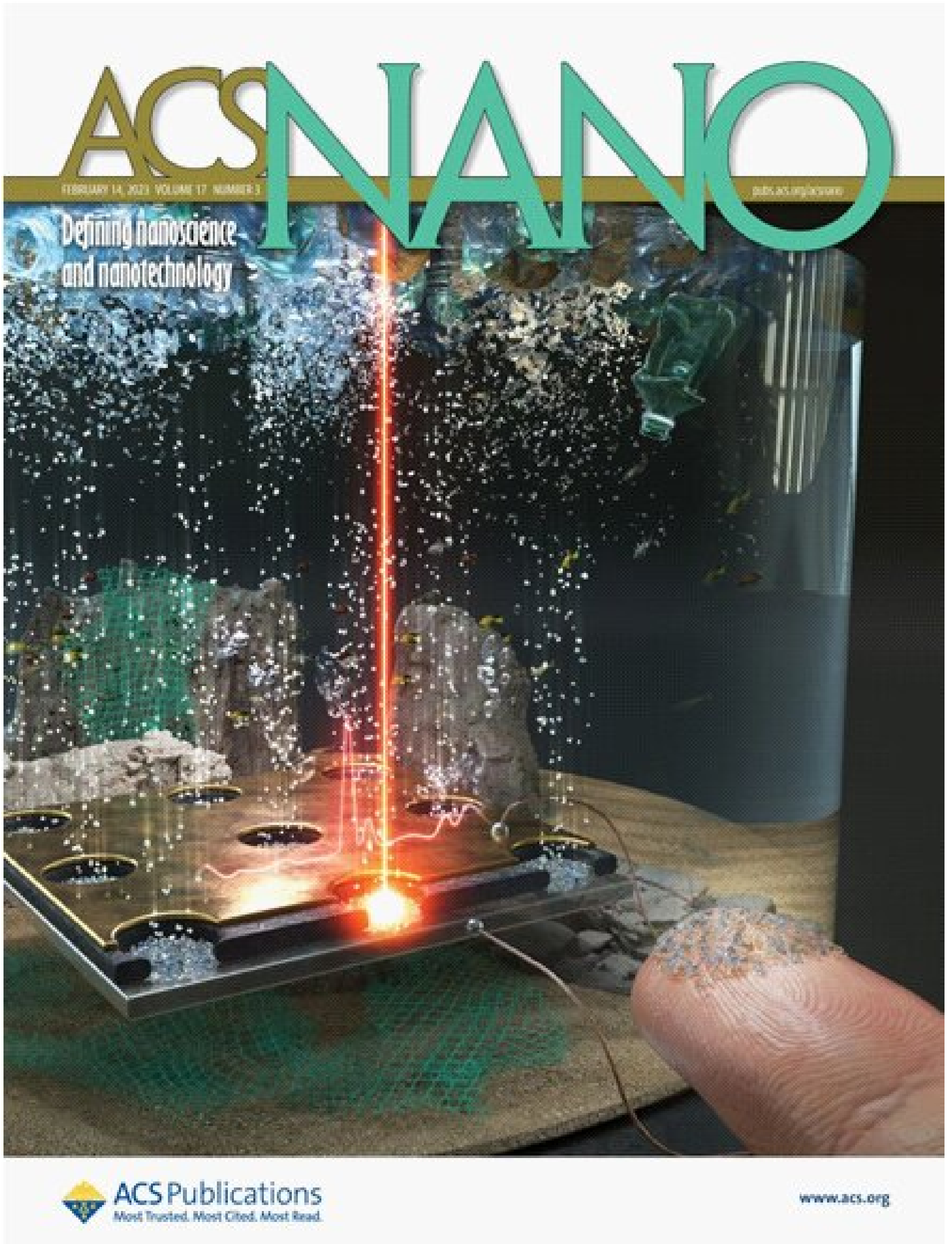
Raman-spectroscopy-based nanoplastic detection using the electric-optical tweezer and via surface-enhanced Raman scattering and the subsequent amplification of optical signals as well as the reduction of the accumulation time.Top right: Mimetic diagram of subsequent accumulation time reduction (blue: existing, red: current research)Bottom right: Mimetic diagram of subsequent amplification of optical signal accordingly (blue: existing, red: current research). Credit: Korea Institute of Science and Technology

Nanoplastics are plastics that have been discarded from our daily lives and that enter ecosystems in the size scale below 1 μm after their physical and chemical disintegration. Recent research has shown that the concentration of microplastics in the major rivers in South Korea is the highest worldwide; it is not unusual to find news reports about the detection of microplastics in simple tea bags or drinking water.

The impact of micro/nanoplastics on human health and the environment in general is considered significant. However, the detection of nanoplastics is limited because their concentration is low and their size is extremely small. In addition, the detection process requires a few hours to days, and incurs significant costs during the pre-processing step of concentrating the plastic sample.

The research team of Dr. Yong-sang Ryu at the Brain Research Institute of the Korea Institute of Science and Technology (KIST) have used an electro-photonic tweezer along with metal nanoparticles to concentrate ultrafine nanoplastics within a short time period, and they report the development of a real-time detection system using light.

The research team supplied electricity to a large-area vertically-aligned metal sandwiched by a nanofilm insulator. They conducted Raman spectroscopy, which analyzes the energy difference between the incident and scattered light according to the frequency of the molecule. By combining the two techniques—electrical nanoparticle capture together with real-time Raman spectroscopy—the research team achieved the detection of a 30-nm 10 μg L-1 polystyrene particle with the help of gold nanoparticles via surface-enhanced Raman spectroscopy.



ACS Nano front cover selection. Credit: *ACS Nano*

In addition, the research team easily separated the particle from the sample through the dielectrophoresis phenomenon. Thus, the entire process including the collection, separation, and analysis, which previously required at least one day, was reduced to only several seconds by employing an original technology that separates and detects plastics using one platform.

The study is published in the journal *ACS Nano*.

Researchers Euitae Jeong and Dr. Eui-Sang Yu at KIST who performed this research stated, "The findings of this research are meaningful in that ultrahigh-sensitivity detection of microplastics in real-time has become possible, and the proposed approach can be extended to the measurement of the microplastic concentration in various water resources and applied as a water resource securement technology."

More information: Eui-Sang Yu et al, Real-Time Underwater Nanoplastic Detection beyond the Diffusion Limit and Low Raman Scattering Cross-Section via Electro-Photonic Tweezers, *ACS Nano* (2022). DOI: 10.1021/acsnano.2c07933

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