Chiro-optical force observed at the nanoscale

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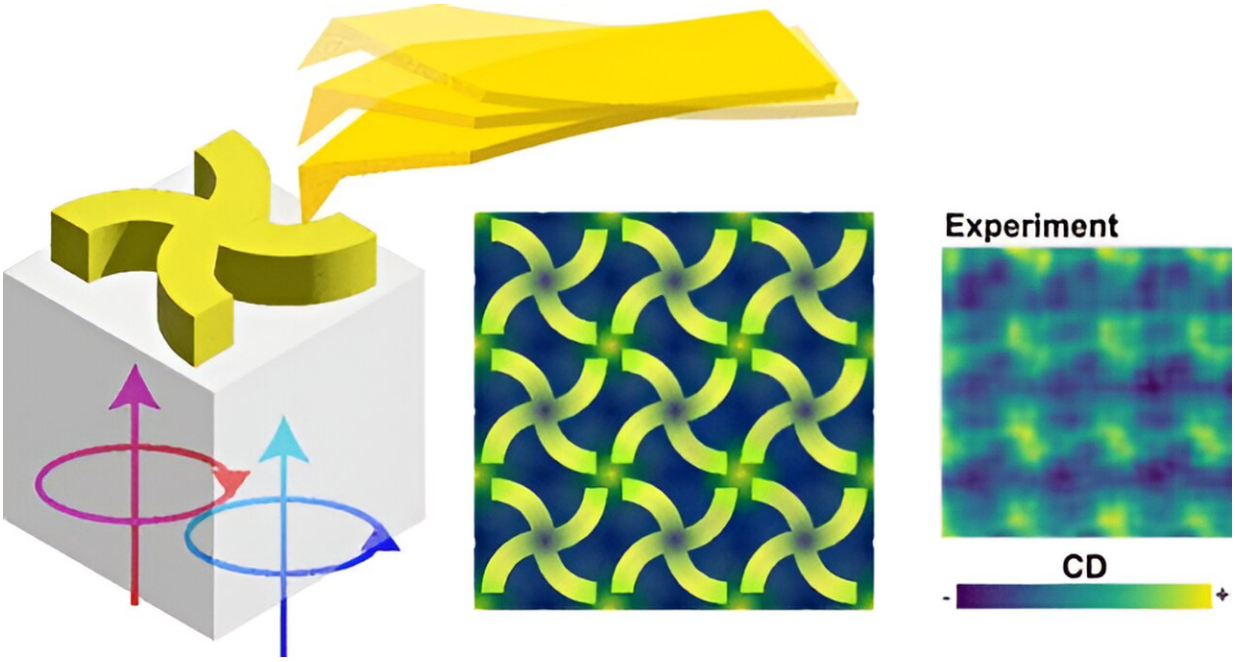

Graphical abstract. Credit: *Nano Letters* (2023). DOI: 10.1021/acs.nanolett.3c02534

A research group at the Institute for Molecular Science has successfully observed the left and right handedness of material structures at the nanoscale, by illuminating chiral gold nanostructures with circularly polarized light and detecting the optical force acting on a probe near the nanostructures. This result demonstrated that it is possible to analyze the chiral structure of matter at the nanoscale using light.

Chirality describes the property of a material structure not being superimposable onto its mirror image. Since the left and right hands, which are mirror images of each other, do not coincide (they are not the same), they are chiral.

Chiral objects can be distinguished to right- or left-handedness. Many substances that constitute life are chiral, and often only one of either the right- or left-handedness naturally exists. Also, in new functional materials, their chiral nature often plays an important role for the functions.

One characteristic of such chiral materials is to exhibit different responses to right- and left-circularly polarized light, known as the chiro-optical effect. However, observation of the chiro-optical effect at the nanoscale, occurring near a chiral substance, had not been realized until now.

In this study, the chiro-optical effect at the nanoscale was observed by using Photo-induced Force Microscopy under optical force mode (OF-PiFM), which detects the optical force exerted on the tip near the illuminated object. Although it was theoretically considered that the chiro-optical effect at the nanoscale could be observed using OF-PiFM, no actual observations had been reported. The paper is published in the journal *Nano Letters*.

The research group successfully observed the chiro-optical effect at the nanoscale by detecting the optical force induced on the probe near the chiral gold nanostructure illuminated with right- and left-circularly polarized light using OF-PiFM.

As a sample to verify the effectiveness of this method, the research group used a gammadion-shaped gold nanostructures.

As a result of imaging the gammadion structures with OF-PiFM, different images were obtained when illuminating with right-circularly polarized light compared to left-circularly polarized light.

These results clarify that local right- or left-handedness at the nanoscale can be distinguished and observed using OF-PiFM with circularly polarized light.

More information: Junsuke Yamanishi et al, Nanoscopic Observation of Chiro-Optical Force, *Nano Letters* (2023). DOI: 10.1021/acs.nanolett.3c02534

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