Researchers employ antennas for angstrom displacement sensing

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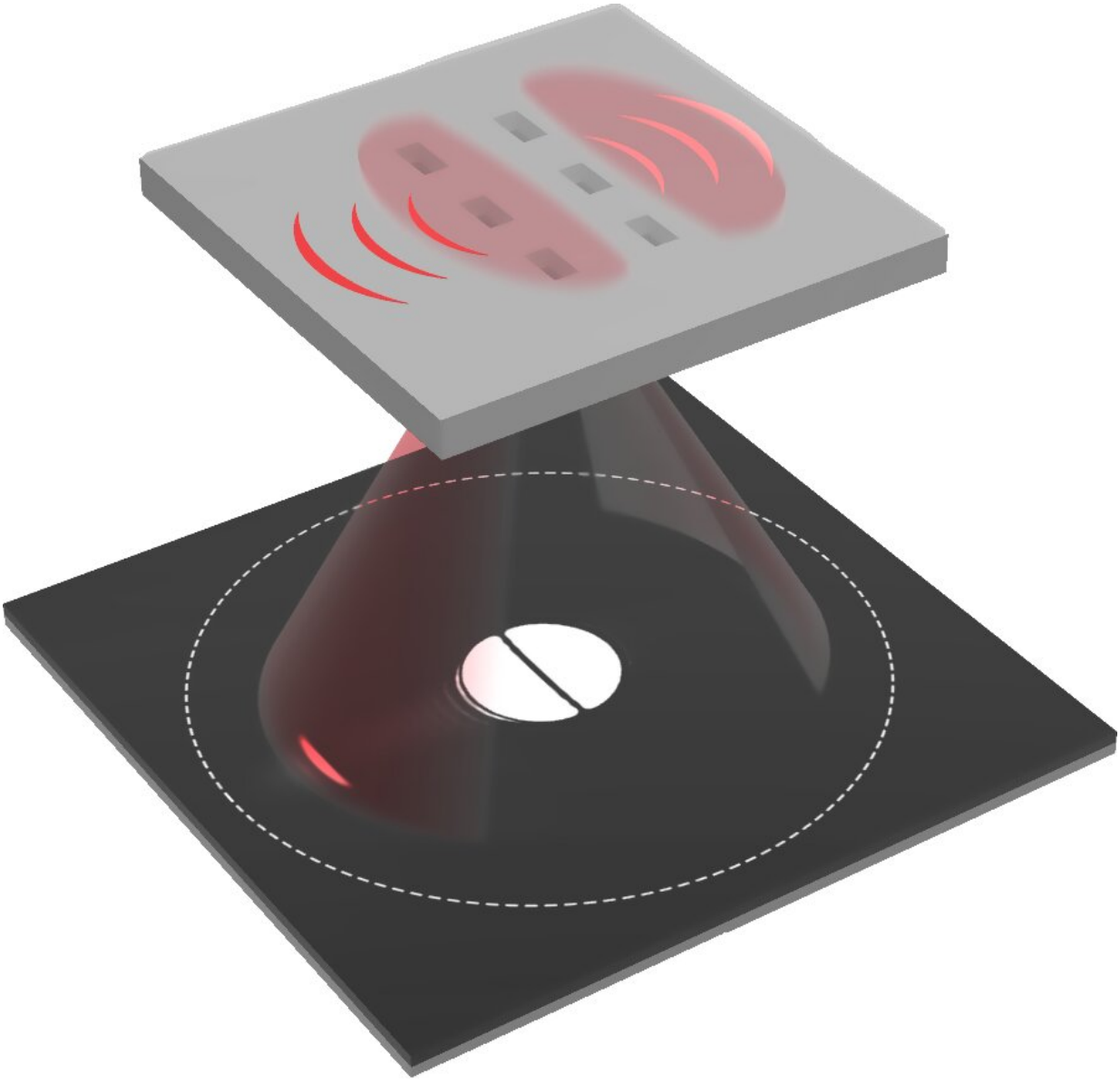

Schema of the near-field interaction between the antennas and incident light field. Credit: Zang Tianyang et al.

The Micro-nano Optics and Technology Research Group led by Prof. Lu Yonghua and Prof. Wang Pei from University of Science and Technology of China (USTC) of the Chinese Academy of Sciences (CAS) realized nanometric displacement measurement through the interaction between the illumination optical field and the optical antennas. This study was published on *Physical Review Letters*.

Optical metrology is of particular significance because it allows measurements of distance or displacement in a noncontact high-precision way. However, despite the wide application in longitudinal displacement measurement of interferometric methods, such as laser radar, laser ranging and small vibration measurement, lateral displacement perpendicular to the direction of the beam is difficult to detect through conventional methods.

The researchers presented a novel technique based on directional excitation of surface plasmon polaritons (SPPs).

They first excited asymmetric SPPs with a pair of optical slot antennas under the illumination of a focused Hermite-Gaussion (HG) (1,0) mode light. Then, by detecting the SPP leakage at the back-focal plane of an oil-immersed objective, they sensitively measured the transverse displacement.

Unlike the previous strategy to retrieve the free scattering signals, which remains challenging even when employing a weak measurement technique, the SPP leakage pattern is spatially separated from the forward scattering of the slot antennas, and thus could be utilized to

monitor displacements in the back-focal plane.

The resolution of their system reaches subwavelength level (~0.3 nm). However, the extreme resolution could be down to the angstrom level. It is potentially applicable in superresolution microscopy, semiconductor lithography, and calibration of nanodevices.

More information: Tianyang Zang et al, Asymmetric Excitation of Surface Plasmon Polaritons via Paired Slot Antennas for Angstrom Displacement Sensing, *Physical Review Letters* (2020). DOI: 10.1103/PhysRevLett.124.243901

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