Argonne NATIONAL LABORATORY

DYNAMIC LENS-ON-MEMS **BRINGS NEW VISION TO OPTICS**

THE IMPETUS

Current metasurfaces are static optical elements that cannot be reconfigured after fabrication. Incorporating metasurfaces onto microelectromechanical systems (MEMS) devices creates a unique and agile lens-on-MEMS technology that paves the way for novel miniature optical systems.

A MEMS-integrated metasurface lens prototype introduces dynamic control of a new class of compact, lightweight and flat optical devices. These devices are planar counterparts of bulky optical components with the potential to reduce the size of conventional optical systems, but their static nature limits their applications. Introducing active control will greatly expand their function in optical technologies.

THE WORK

The design involves a two-dimensional scanner micro-mirror that focuses light in the mid-infrared spectrum. When electrostatically actuated, the MEMS platform controls the angle of the lens along two axes, allowing scanning of the focal spot by about nine degrees in each direction.

The multi-diameter, disc-shaped resonators are distributed across the planar lens and separate incident and reflected beams, avoiding the need for a beam splitter. Characterization comparing mechanical response of the MEMS with and without the flat lens shows similar results, and optical focusing performance obtained experimentally confirms simulated results.

Design, fabrication and characterization were performed using optical lithography and laser capabilities at the Center for Nanoscale Materials, a U.S. Department of Energy Office of Science user facility located at Argonne National Laboratory, and at Harvard University.

THE IMPACT

This new dynamic metasurface lens has potential across wider fields, such as MEMS-based microscope systems and holographic and projection imaging. Designs with thousands of individually controlled devices onto a single silicon chip could lead to an unprecedented degree of control and manipulation of the optical field.

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