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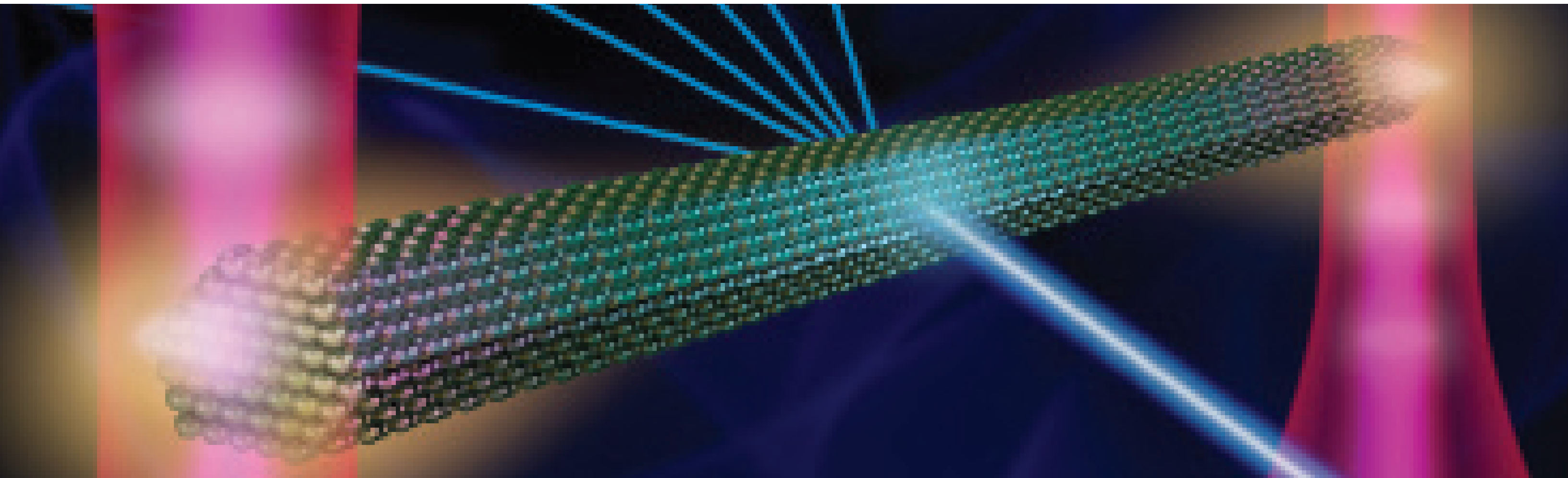

OPTICAL "TWEEZERS" **ENABLE ANALYSIS OF CRYSTALS IN LIQUIDS**

THE IMPETUS

Optical trapping is a known noncontact sample manipulation technique to study the structure and dynamics of nano- and mesoscale objects without inducing undesired changes in structure. Combining optical trapping with hard X-ray microscopy techniques, such as coherent diffraction imaging and crystallography, provides a nonperturbing environment where electronic and structural dynamics of an individual particle in solution can be followed in situ. A team of researchers at the Center for Nanoscale Materials (CNM), a U.S. Department of Energy (DOE) Office of Science user facility located at Argonne National Laboratory, together with users and collaborators from Argonne, Brookhaven National Laboratory, the University of Chicago, Clarkson University and the University of Maryland, demonstrate that dynamic holographic optical tweezers are capable of manipulating single micrometer-scale anisotropic particles in a microfluidic environment with the precision and stability required for X-ray Bragg diffraction experiments — thus functioning as an "optical goniometer."

THE WORK

This work demonstrates that dynamic holographic optical tweezers are capable of manipulating single micrometer-scale anisotropic particles in a fluid environment with the precision and stability required for synchrotron X-ray diffraction experiments. This noncontact sample manipulation technique of optical trapping allows for manipulating single particles in solution, without inducing undesired changes in structure, to obtain three-dimensional maps of shape and strain.

Microfluidic cell fabrication and electrodynamics simulations were performed on Carbon, CNM's high performance computing cluster. X-ray diffraction data were collected at beamline 34-ID-C at Argonne's Advanced Photon Source, a DOE Office of Science user facility. This method, based on dynamic holographic optical trapping in a standing-wave geometry, allows sufficient angular stability to perform Bragg coherent X-ray diffraction imaging.

THE IMPACT

Obtaining a fundamental understanding of crystal growth and chemical reactions in solution is of broad interest for materials discovery, structural biology and catalysis.

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