ChE SEMINAR

Construction and Future Applications of X-ray (and Neutron) Tomography with Stepped-Grating Interferometer

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http://chemistry.lsu.edu/People/Faculty/Les%20Butler/item939.html

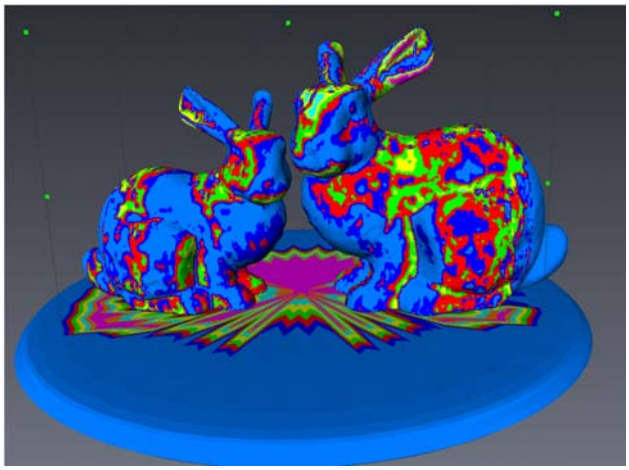
Seminar Room
Dept. of Chemical Engineering
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ABSTRACT

An X-ray interferometer is being constructed at the LSU CAMD synchrotron, a 2nd generation synchrotron with a newly installed 7-Tesla, 11-pole wiggler and double-crystal Laue monochromator. As this time, the Laue monochromator is undergoing crystal alignment. In addition, a laboratory-based system is also under construction; this instrument is designed for larger, stationary samples as it will have the X-ray source and detector mounted on a rotating gantry.

With 70 keV interferometry, new opportunities are opened in materials science imaging. We have experience since 2011 at the Advanced Photon Source synchrotron with 20 to 35 keV interferometry, both stepped-grating and checkerboard single-shot interferometry. This low-energy interferometry has been extremely useful, but issues of phase wrap as well as excessive X-ray absorption in some samples have motivated the construction of the 70 keV system. The sample limitations imposed by a synchrotron source have motivated the construction of the laboratory system. And when neutrons are needed, the ORNL Spallation Neutron Source has just received approval for the VENUS neutron imaging beamline which will have grating interferometry.

Stepped-grating X-ray interferometry has been shown to be robust imaging method for materials, biomaterials, and with rapidly evolving medical applications. The imaging modalities–absorption, differential phase contrast, and dark-field–cover a wide range of contrast mechanisms. One such application will be 3D printing: This imaging experiment is nicely suited for addressing question of 3D printhead performance and optimization. In the single-shot interferometry mode, X-ray movies can be acquired. The LSU systems should operate at 30 Hz or faster. The SNS neutron system will be operated in pulsed, time-of-flight mode for synchronized imaging.



A pair of “Stanford Bunnies” printed with PLA and then imaged with X-ray tomography. The color represents the dimensional error between the STL print file and the surface of the tomography volume (Prof. Shane Li, LSU CCT).

ABOUT THE SPEAKER

Les Butler received his BS (1977) from the University of Arkansas, then studied inorganic chemistry with Prof. Ted Brown at the University of Illinois at Urbana-Champaign. His PhD (1981) research was the construction of a novel solid-state NMR spectrometer and its applications to inorganic materials. Postdoctoral research (1981-93) in photochemistry and solid-state chemistry was done at CalTech with Prof. Harry Gray. He started at LSU as an assistant professor in 1983. His group built several solid-state NMR spectrometers and used magnet facilities at the National High Magnetic Field Laboratory and Los Alamos to study organometallic complexes, catalysts, polymer blends, biological samples, and environmental samples. He spent two years at the National Science Foundation (2001-02) as a program officer in chemistry. Now, his research program has moved in 3D+ imaging with X-ray and neutrons, mostly in materials science and polymer blends.