Berkeley Synchrotron Infrared Structural Biology (BSISB) Program: A Bioanalytical Facility for Characterizing Chemical Changes in Living Cells

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Project Goals: A DOE Structural Biology User Facility for accelerating biological research

The Berkeley Synchrotron Infrared Structural Biology program (BSISB) is funded by the Department of Energy to provide support to researchers whose work can benefit from real-time measurements and imaging of chemical changes in living cells while biological processes are underway. The BSISB program has developed synchrotron radiation-based Fourier transform infrared (SR-FTIR) spectromicroscopy, which is ideally suited to measure at a chemicallevel how microbes adapt to changing environments. SR-FTIR spectromicroscopy is similar to the well-established non-invasive molecular analytical technique Fourier transform infrared (FTIR), except SR-FTIR is capable of discovering molecular information with micrometer spatial accuracy and signal-to-noise ratios 100 to 1000 times greater. Aqueous environments hinder SR-FTIR's sensitivity to bacterial activity, but the recent development of integrated in situ open-channel microfluidic culturing platforms circumvents the water-absorption barrier. These platforms enable real-time chemical imaging of bacterial activity in biofilms and facilitate comprehensive understanding of structural and functional dynamics in a wide range of microbial systems. Recently, the BSISB program has added visible (VIS) hyperspectral/fluorescence microscopy to its multi-modal imaging capability. Users can simultaneously track changes in cellular morphology, structure, and biological processes like gene expression and signaling during SIR experiments. The presentation will include examples that demonstrate the use of BSISB in wide ranging research projects that are important to DOE missions.