Observing Molecular-Level Transient Oxygen Stress in Obligate Anaerobes In Vivo

Hoi-Ying N. Holman[1,2,*], E. Wozei[1], Z. Lin[3], and T.C. Hazen [1,2]

[1]Ecology Department, Lawrence Berkeley National Laboratory, One Cyclotron Rd., Berkeley, California, 94720 US.

[2]Virtual Institute for Microbial Stress and Survival, http:// vimss.lbl.gov.

[3]Fujian Institute of Research on Structure of Matter, Chinese Academy of Science, China

*To whom correspondence should be addressed. E-mail: hyholman@lbl.gov

ABSTRACT

Aerobic respiration of intracellular polyglucose reserves is postulated to play a central role in oxygen adaptive response in obligatory anaerobes like *Desulfovibrios*, but it has been difficult to probe this event at chemical scale *in vivo*. Here we present a non-invasive synchrotron infrared (SIR) spectromicroscopy approach to reveal time-dependent composition and structure changes at a lateral scale of several individual *Desulfovirbio vulgaris*. The advantage of infrared spectroscopy is that it is non-invasive, and it uses vibration movements of atoms and chemical bonds within functional groups of biomolecules as an intrinsic contrasting mechanism; thus it allows one to immediately detect composition and structure changes within living cells. The advantage of using a synchrotron light source is that its high brightness allows us to detect signals ~1000 times weaker then the conventional infrared spectroscopy allows us to. Comparative analysis of SIR spectra of the same individual *D. vulgaris* exposed to air-level oxygen at different time points reveals chronological information regarding the level of oxidative stress and the extent of cellular injury and repair. These results, together with microscopy images, mark a critical step toward the use of SIR spectromicroscopy as an uninterrupted microprobe at a chemical scale level of physiological events in microbiology applications.

* Corresponding author phone: (510)486-5943; fax: (510)486-7152; e-mail:hyholman@lbl.gov