Electrocatalytic and Spectroscopic Studies on Cytochrome bd Oxidase, a Highly Diverse Bacterial Defense Factor

Iryna Makarchuk[a], Jan Kaegi [b], Alexander Thesseling[b], Frederic Melin[a], Thorsten Friedrich[b], Petra Hellwig[a]

[a] Laboratoire de Bioélectrochimie et Spectroscopie, UMR 7140, Chimie de la Matière Complexe, Université de Strasbourg – CNRS 4, rue Blaise Pascal, 67081 Strasbourg, France ;
[b] Institut für Biochemie, Albert-Ludwigs-Universität Freiburg, Freiburg, Germany;
hellwig@unistra.fr

The selective reduction of oxygen to water is crucial to life and a central process in aerobic organisms. It is catalyzed by several different enzymes, including cytochrome *bd* oxidases (cyt *bd*) that are solely present in prokaryotes, including several pathogens. In addition, these enzymes play a crucial role in protection against oxidative stress, in virulence, adaptability and antibiotics resistance. The reduction of O_2 occurs at the high spin D-type heme in all cyt *bd* oxidases, that is also the binding site for several ligands from signaling processes, including CO, H_2S and CO.

Here we present the electrocatalytic study of the cytochrome *bd* I and *bd* II oxidases from *Escherichia coli*. [(1,2)] Structural parameters that are crucial for the reactivity towards oxygen are analyzed on the basis of redox induced FTIR difference spectra. The pH dependency of the binding and release of NO, an important signaling factor is presented. Finally, the question why *E. coli* comprises two highly comparable cytochrome *bd* oxidases is discussed.

(1) Grauel, A. Kägi, J. Rasmussen, T. Makarchuk, I. Oppermann, S. Moumbock, A., Wohlwend, D., Müller, R., Melin, F., Günther, S., Hellwig, P., Böttcher, B., and Friedrich, T., 'Structure of Escherichia coli cytochrome bd-II type oxidase with bound aurachin D' (2021) Nat. Commun., 12:6498.

(2) Nikolaev, A., Safarian, S., Thesseling, A., Wohlwend, D., Friedrich, T., Michel, H., Kusumoto, T., Sakamoto, J., Melin, F., Hellwig P. 'Electrocatalytic evidence of the diversity of the oxygen reaction in the bacterial bd oxidase from different organisms' (2021) Biochim. Biophys. Acta 1862, 148436.