CeNT CENTRE OF NEW TECHNOLOGIES

UNIVERSITY OF WARSAW

invites to a seminar by

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Towards oxygen-insensitive [FeFe]-hydrogenases

February 2 2017 at 1:00 p.m.

at the Centre of New Technologies, Banacha 2c,
room 0142 (ground floor)

Abstract: [FeFe]-hydrogenases are the best natural hydrogen producing enzymes1 but their biotechnological exploitation is hampered by the extreme oxygen sensitivity of these proteins. Most of the previous theoretical studies put emphasis on explanation of the irreversibility of this process as they were related to experiments carried out under constant O2 concentration. However, we have recently shown experimentally that such aerobic inactivation is partially reversible.2,3 Here we combined the molecular dynamic (MD) simulations of the the dioxygen diffusion in the [FeFe] hydrogenase, extracted from Clostridium Pasteurianum, with the high level ab initio calculations of the O2 binding and its transformations at the active site of the protein.3,4

We found that the partial reversibility results from the four-electron reduction of O2 to water.3 The third electron/proton transfer step is the bottleneck for water production, competing with formation of the highly reactive hydroxyl radical (·OH) and cysteine sulfenic acid (Cys299-SOH), consistent with the recent crystallographic evidence.5 The rapid delivery of electrons and protons to the active site is therefore crucial to prevent the accumulation of these harmful species upon exposure to oxygen. Moreover, our Markov state modelling6 of the diffusion process identified key residues that should be the target of the future mutational studies aiming to restrict O2 access to the active site of the [FeFe] hydrogenases. In this presentation we will also present first results concerning the fine-tuning role of the unique ligands of the iron-sulfur clusters that form the electron delivery chain