Protonation pathway modelling in cytochrome c oxidase

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Cytochrome c oxidase (CcO) is the final enzyme in the aerobic respiration in mitochondrial and bacterial membranes. In an exergonic redox-reaction, CcO catalyzes the reduction of dioxygen to water and is coupled with endergonic proton transfer across the membrane thereby creating an electrochemical gradient. Intensive research has been performed but it is still an intriguing question how CcO achieves the unidirectional proton transport and avoids short circuit of the pump.[1-4]
Our work is focused on characterization of the proton transfer pathways of CcO in their electrostatic and energetic properties. This is an important step towards an understanding of the function of CcO.
Methods include the quantum mechanical calculation of partial charges of the cofactors, molecular modeling of water molecules and side chain conformations and finally electrostatic pKA calculations solving the linearized Poisson-Boltzmann equation. From the pKA values of titrable molecular groups, the energy barriers for proton transfer can be estimated.[5,6]

References:

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