

Molecular electrocatalysis for hydrogen production and oxidation: how do proton relay allow for bidirectional/reversible behavior?



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Catalysis in hydrogenases and other metalloenzymes involved in CO₂ transformation only requires Earth-abundant metal centers, the reactivity of which is enhanced thanks to the presence of basic sites acting as proton relays [1] at their vicinity. Such active sites have been used as an inspiration to design new synthetic catalysts for H₂ evolution [2-4] and oxidation [5,6]. Specifically, catalytic platforms with installed proton relays display bidirectional [7] and, in rare cases, reversible catalysis [5]. In this presentation we will show how a detailed molecular electrochemistry study can help understanding and quantifying the role of the proton relays related to these remarkable behaviors [8]. We will then show how the immobilization of such biomimics onto surfaces allows the preparation of electrode materials approaching industrial current densities and compatible with existing PEM electrolysis technology [6, 9-11], allowing for the assembly of noble-metal free H₂/O₂ fuel cells [9,11,12].

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Professor Vincent Artero received the Ph.D. degree in 2000 under the supervision of Prof. A. Proust. His doctoral work dealt with organometallic derivatives of polyoxometalates. After a postdoctoral stay at the University of Aachen (Aix la Chapelle) with Prof. U. Kölle, he joined in 2001 the group of Prof. M. Fontecave in Grenoble with a junior scientist position in the Life Science Division of CEA. In 2016, he became Research Director at CEA. In addition to the SolHyCat group, he now leads the Laboratory of Chemistry and Biology of Metals. His research interests are in bio-inspired chemistry including catalysis related to hydrogen energy and artificial photosynthesis. He has been granted with a Consolidator Grant from the European Research Council (ERC, photocath2ode project 2012-2017). He acted as vice-chair of the COST Action CM1202 on supramolecular water splitting (2012-2016) and as co-head of the French network (CNRS-Groupement de recherche) on Solar Fuels (2026-2020). He's a member of the Young academy of Europe (YAE). He currently chairs the board of management of the ARCANE Excellence Laboratory Network (LABEX) for bio-driven chemistry in Grenoble. Vincent Artero is associate editor of the Royal Society of Chemistry flagship journal "Chemical Science".

