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RESEARCH INTERESTS

- Catalysis and biocatalysis
- Coordination and organometallic chemistry
- Solid and surface chemistry
- Bioinspired chemistry
- Protein chemistry and enzymology
- Bioinorganic chemistry

SUMMARY

Marc Fontecave is Professor at the Collège de France in Paris and member of the Academy of Sciences. His research activity aims at understanding the molecular structure and the chemical reactivity of complex redox biological (bioorganic and bioinorganic) systems and at developing bioinspired synthetic systems. The strategy is to tackle these questions through a multidisciplinary approach based on the concepts and methods of protein chemistry, enzymology, molecular and structural biology, in one hand, and synthetic organic and inorganic chemistry in the other hand, to develop original catalytic and biocatalytic systems. The enzymes (flavoproteins and metalloenzymes) under investigation are selected for their physiological importance, for the novelty of the chemistry they carry out and for their potential applications in health, energy and environmental sciences. As examples of research projects: (i) characterization of iron-sulfur enzymes involved in the modification of biological macromolecules with special emphasis on tRNA modification; (ii) characterization of the protein machineries involved in the biosynthesis of biological cofactors (iron-sulfur clusters, active site of hydrogenases, ubiquinone). The bioinspired chemical approach not only contributes to understand key biological systems and reactions at the molecular level but also allows discovering original catalysts useful for synthetic reactions. A major project within the general field of "artificial photosynthesis" is dealing with the preparation and evaluation of novel bioinspired, molecular as well as solid, catalysts based on non-noble metals for their implementation in solar energy storage technological devices (electrolysers and photoelectrochemical cells). The reactions under investigation are (i) water splitting into hydrogen and oxygen; (ii) reduction of carbon dioxide into energy-dense compounds (carbon monoxide, formic acid, hydrocarbons, alcohols).

Selected publications

- From Hydrogenase Mimics to Noble-Metal Free Hydrogen-Evolving Electrocatalytic Nanomaterials. A. Le Goff, V. Artero, B. Jousselme, N. Guillet, R. Métayé, A. Fihri, S. Palacin, **M. Fontecave**. ***Science*** 2009, 326, 1384-1387
- Splitting Water with Cobalt. V. Artero, M. Chavarot-Kerlidou, **M. Fontecave**. ***Angew. Chem.Int. Ed.*** 2011, 50, 7238-7266
- Two Fe-S clusters catalyze sulfur insertion by radical-SAM methylthiotransferases. F. Forouhar, S. Arragain, M. Atta, S. Gambarelli, J.-M. Mouesca, M. Hussain, R. Xiao, S. Kieffer-Jaquinod, J. Seetharaman, T. B. Acton, G. T. Montelione, E. Mulliez, J. F. Hunt, **M. Fontecave.** ***Nature Chemical Biology*** 2013, 9, 333-338
- Biomimetic assembly and activation of [FeFe]-hydrogenases. G. Berggren, A. Adamska, C. Lambertz, T. Simmons, J. Esselborn, M. Atta, S. Gambarelli, JM Mouesca, E. Reijerse, W. Lubitz, T. Happe, V.Artero, **M. Fontecave**. ***Nature***, 2013, 499, 66-70
- The [FeFe]-hydrogenase maturation protein HydF : Structural and Functional Characterization. G. Caserta, L. Pecqueur, A. Adamska-Venkatesh, C. Papini, S. Roy, V. Artero, M. Atta, E. Reijerse, W. Lubitz**, M. Fontecave**. ***Nature Chem. Biol.*** 2017, 13, 779-784
- Non redox thiolation in transfer RNA occuring via sulfur activation by a [4Fe-4S] cluster. S. Arragain, O. Bimai, P. Legrand, S. Caillat, J.-L. Ravanat, N. Touati, L. Binet, M. Atta, **M. Fontecave**, B. Golinelli-Pimpaneau. ***Proc. Natl. Acad. Sci.*** 2017, 114, 7355-7360
- Pyranopterin Related Dithiolene Molybdenum Complexes as Homogeneous Catalysts for CO_2 Photoreduction. T. Fogeron, P. Retailleau, L.-M. Chamoreau, Y. Li, **M. Fontecave**. ***Angew. Chem. Int. Ed. Engl.*** 2018, 57, 17033-17037
- Electroreduction of CO_2 on Single-Site Copper-Nitrogen-Doped Carbon Material: Selective Formation of Ethanol and Reversible Restructuration of the Metal Sites. D. Karapinar, Ngoc Tran Huan, N. Ranjbar Sahraie, D. W. Wakerley, N. Touati, S. Zanna, D. Taverna, L.H. Galvão Tizei, A. Zitolo, F. Jaouen, V. Mougel, **M. Fontecave.** ***Angew. Chem. Int. Ed. Engl.*** 2019, 58, 15098-15103
- Low-cost high efficiency system for solar-driven conversion of CO_2 to hydrocarbons. Huan Ngoc Tran, D. Alves Dalla Corte, S. Lamaison, L. Lutz, N. Menguy, M. Foldyna, S.-H. Turren-Cruz, A. Hagfeldt, F. Bella, **M. Fontecave**, V. Mougel. ***Proc. Natl. Acad. Sci.*** 2019, 116, 9735-9740
- High Current Density CO2-to-CO Electroreduction on Ag-Alloyed Zn dendrites at Elevated Pressure. S. Lamaison, D.Wakerley, J. Blanchard, D. Montero, G. Rousse, D. Mercier, P.Marcus, D.Taverna, D. Giaume, V. Mougel, **M. Fontecave**. ***Joule*** 2020, 4, 395-406