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#ICMolTalks

Dr. Ernest Pastor

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December 19th - 12:00h

Assembly Hall - ICMol

Abstract

Controlling the excited state of photocatalysts

[1]CNRS, Univ Rennes, Institut de Physique de Rennes, Rennes, France
[2]CNRS, Univ Rennes, DYNACOM (Dynamical Control of Materials Laboratory) - IRL2015, The University of Tokyo, Tokyo, Japan.

Sunlight-to-chemical conversion requires systems that generate long-lived excited states upon illumination. However, this comes with a big energy penalty. [1] For example, the natural photosynthesis system sacrifices up to half of its light energy input to gain the carrier lifetimes necessary to drive chemical reactions.[2] Similarly, in artificial photosynthetic devices, lifetime gain is typically achieved through the application of external electrical bias [3] or the use of sacrificial reagents.[4] Currently, there is no established blueprint for designing semiconductors with intrinsically long lifetimes. In this talk, I will discuss an experimental and theoretical model that points towards a link between carrier lifetime and the electronic configuration of transition metal oxides (TMOs). I will show time-resolved data of a series of TMOs, which suggest that their photocatalytic performance is constrained by the presence of a metal-centred ligand field (LF) states, analogous to those previously observed in molecular complexes.[5] By drawing comparisons with molecular systems, I will discuss possible strategies to control and extend carrier lifetime in semiconductors and highlight potential routes to tune the quantum yield of photocatalysts on demand.

References
[1] Pastor et al. Nat. Rev. Mater. 2022, 7. 503-521
[2] Godin, R. & Durrant, J. R. Chem. Soc. Rev. 2021, 50, 13372–13409
[3] Pendlebury, S. R. et al. J. Am. Chem. Soc. 2014, 136, 9854–9857
[4] Pellegrin, Y. & Odobel, F. Comptes Rendus Chim. 2017, 20, 283–295
[5] Sachs et al. Nat. Chem. 17, 1348–1355 (2025).

Biography

Ernest Pastor is a CNRS Junior Professor Chair (CNRS Physics) since 2023. Previously, he studied Chemistry at the University of Valencia and did a PhD in Photochemistry at Imperial College London. He has worked as a researcher in Spain (fellow at ICFO and INAM), the UK and the USA (postdoc at Imperial College and the Berkeley National Lab). Ernest uses ultrafast lasers, x-ray radiation and electrochemistry to study functional solids, such as catalytic oxides or phase-change materials. He is interested in using laser pulses to manipulate defects and structural imperfections. In 2022 Ernest was awarded an ERC Starting Grant to explore how light can be used to study and control polarons and defects in solids for energy conversion and storage applications.

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