Charge carrier dynamics in metal oxides

Fact Sheet

Project Information

DYNAMOX

Grant agreement ID: 695197

Project website

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10.3030/695197

Project closed

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1 October 2016

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31 March 2022

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EXCELLENT SCIENCE - European Research Council (ERC)

Total cost
€ 2 482 305,00

EU contribution
€ 2 482 305,00

Coordinated by
ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE
Switzerland

Objective

Transition metal (TM) oxides (TiO2, ZnO, NiO) are large gap insulators that have emerged as highly attractive materials over the past two decades for applications in photocatalysis, solar energy conversion, etc., all of which rely on the generation of charge carriers, their evolution and their eventual trapping at defects or a self-trapped excitons. Despite the huge interest for such materials, the very nature of the elementary electronic excitations (Frenkel, Wannier or charge transfer exciton) is still not established, nor is the way these excitations evolve after being created: excitonic polaron or charged polaron. Finally, the electron and hole recombine is also not clearly established because of issue of defects and trapping.

In order to tackle these issues, here we implement novel experimental tools that would provide us with hitherto inaccessible information about the charge carrier dynamics in TM oxides. Of importance is the ability to detect both the electrons and the holes. Some of these tools have been developed in the PI's group: i) Ultrafast X-ray absorption spectroscopy (XAS) will provide information about the final metal d-orbitals and about the structural changes around it; ii) Ultrafast X-ray emission (XES) will provide information about hole states. While these two approaches are ideal element-selective ones, the localization of the electron at metal atoms represents a small proportion of the electron population. Therefore, ultrafast Angle-resolved photoemission spectroscopy (ARPES) will be used to map out the band structure changes in the system and the evolution of the conduction band electrons. Ultrafast 2-dimensional (2D) UV (<400nm) transient absorption spectroscopy allows the mapping of the time evolution of both the valence and the conduction bands by its ability to pump and probe above the band gap. Last, Fourier Transform visible 2D spectroscopy will allow the probing of gap state dynamics at high time resolution.

Fields of science (EuroSciVoc)

natural sciences > chemical sciences > catalysis > **photocatalysis**

natural sciences > chemical sciences > inorganic chemistry > **inorganic compounds**

natural sciences > chemical sciences > inorganic chemistry > **transition metals**

natural sciences > physical sciences > **atomic physics**

natural sciences > physical sciences > optics > spectroscopy > **absorption spectroscopy**

Keywords

electrons | holes | band structure | charge trapping | surfaces | Titanium dioxide | Zinc Oxide | Nickel Oxide | nanoparticles | single crystals

Programme(s)

H2020-EU.1.1. - EXCELLENT SCIENCE - European Research Council (ERC) MAIN PROGRAMME

Topic(s)

ERC-ADG-2015 - ERC Advanced Grant

Call for proposal

ERC-2015-AdG

See other projects for this call

Funding Scheme

ERC-ADG - Advanced Grant

Host institution

ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE

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€ 2 482 305,00

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Address

BATIMENT CE 3316 STATION 1
1015 Lausanne
Switzerland

Region

Schweiz/Suisse/Svizzera > Région lémanique > Vaud

Activity type

Higher or Secondary Education Establishments

Links

Contact the organisation Website
Participation in EU R&I programmes
HORIZON collaboration network

Beneficiaries (1)

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