Ultrafast X-ray spectroscopy in Biological and Chemical Catalysis

IMDEA - Nanociencia Institute
www.nanociencia.imdea.org

CENTRE DESCRIPTION

IMDEA Nanociencia is a young interdisciplinary research centre dedicated to the exploration of basic nanoscience and the development of applications of nanotechnology in connection with innovative industries.
Our purpose-built building was inaugurated in 2014 and features state-of-the-art facilities for 21st century science, where the frontiers between fields disappear and Physics, Chemistry, Biology, Engineering, and Medicine merge. It features more than 30 operative laboratories with over € 16 M worth of equipment -including the Centre for Micro and Nanofabrication. We are located at the UAM Campus, with access to all the facilities of one of Spain's largest and most prestigious Universities. The UAM Campus is just a few minutes away from Madrid's lively city centre, connected by "cercanías" trains and several bus lines.

We are over 150 scientists, with different professional and personal backgrounds. Approximately 40% of our PhD and postdocs come from outside Spain, representing every corner of the world, from Germany to China, from the USA to Singapore –a true international environment in which to develop your scientific career. Women make up 36% of our scientific and 62% of our management staff. No matter who you are or where you come from, you will feel welcome from the very first minute.

We take science seriously and value quality over quantity. Our scientists enjoy tackling complex multidisciplinary problems, often within in-house collaborations, so all of our students receive truly interdisciplinary training. We also enjoy publishing in the very best journals, with >200 publications a year, and an institutional h index of 79. Check out our webpage http://nanociencia.imdea.org/, facebook @IMDEANanociencia or twitter @IMDEA_Nano for more information.

So if you are a talented, hard-working individual with a real interest in Science, IMDEA Nanociencia is the right place for you! Come work with us!

ADDRESS

Faraday 9, 28049 Madrid, Madrid

AREA OF KNOWLEDGE

Physical Sciences, Mathematics, and Engineering

GROUP OF DISCIPLINES

Chemistry and Chemical Engineering

GROUP LEADER

Dr. Dooshaye Moonshiram

dooshaye.moonshiram@imdea.org

Research Group Website: http://nanociencia.imdea.org/time-resolved-x-ray-spectroscopy-in-biological-and-chemical-catalysis/group-home

Research project/ Research Group description

Our research group is focused on the development and application of advanced spectroscopic tools for the design of active catalysts for water oxidation, proton reduction, and methane to methanol production processes. Currently, the development of artificial photosynthetic assemblies and biological mimics of naturally methane oxidizing enzymes is of great interest, and has drawn significant attention by exploring molecular catalysts based on 3d transition metal complexes. However in spite of emerging design principles, there is an urgent need to correlate the performance and stability of a catalyst to its geometric structure and electronic configuration for its rational development.

In this regard, we are interested in the development of static and time-resolved X-ray based spectroscopic approaches, including X-ray absorption (XAS) and X-ray emission spectroscopy (XES), to understand the critical electronic, energetic and geometric requirements of the water splitting and methane oxidation reactions necessary for achieving economically feasible catalysts. Our research is particularly oriented towards ultrafast pump(laser), X-ray (probe) studies of metal noble-free photosensitizers, and multimolecular photocatalytic systems for artificial photosynthesis in the femtosecond-microsecond time regime. Combined analysis of experimental data on structures, electronic configurations and spin states provide valuable information to understand the operation mechanism. Further selectivity is achieved through resonant XES or resonant inelastic X-ray scattering spectroscopy.

Synchrotron-based techniques employed in our group are complemented with laboratory-based spectroscopic methods such as UV-Visible spectroscopy, Resonance Raman, Electron Paramagnetic Resonance, Optical transient absorption spectroscopy, and Atomic Force Microscopy. Our studies involve the interplay of several disciplines including synthetic inorganic chemistry, electrochemistry, kinetics and spectroscopy.

Job position description

The project will consist in studying artificial analogues of methane monooxygenase enzymes for dioxygen activation reactions through time-resolved X-ray absorption, emission and laboratory-based techniques with femto-pico second temporal resolution. The main objectives of the project will be to explore the light-induced intramolecular electron transfer dynamics and kinetics to generate the active species responsible for the insertion of oxygen atom transfer in organic substrates.

The focus of the project will be based on synchrotron-based X-ray absorption and emission spectroscopy including valence-to-core XES, resonant XES, pump X-ray/probe laser spectroscopy and optical transient absorption spectroscopy. These studies will in the long term be complemented with studies at the X-ray free electron lasers and table top high harmonic sources where femtosecond time resolution is possible.

The recruited predoctoral fellow will assist in defining the study, writing the beamtime proposals, and carrying out the synchrotron and laboratory-based experiments, data analysis and interpretation. A summary of the required qualifications include a phd in chemistry, physics or biological Science and strong analytical skills, written and verbal communication skills.