PhD position in chemistry – UQAM and Université de Sherbrooke

Better materials for green hydrogen

Project: Unlocking the secrets of $BiVO_4$ photocatalysts at the nanoscale for green hydrogen production

Research co-supervision by Guillaume Goubert[a] and Mohamed Siaj[b]

a. Université du Québec à Montréal (UQAM), Department of Chemistry, Montréal, QC, Canada

b. Université de Sherbrooke, Department of Chemical and Biotechnological Engineering, Sherbrooke, QC, Canada

Start date: from January 2027 – for a duration of 3 years
Application deadline: open until the position is filled
Funding: minimum of 21,000 CAD per year

Project description:

This project contributes to the development of sustainable fuels. Candidates will have the opportunity to develop advanced skills in materials chemistry and to gain expertise in *in situ* instrumentation within an interdisciplinary environment. These skills, applicable in the energy and semiconductor sectors, open career opportunities in both academia and industry.

The doctoral student will be based primarily in Montréal (UQAM), with opportunities for travel and stays at Université de Sherbrooke over the course of the project.

Objective: Design more active photocatalysts for oxygen evolution by gaining a new understanding of charge-carrier recombination through advanced *in situ* nanospectroscopy.

Keywords: photocatalysis, green hydrogen, $BiVO_4$, 2D materials, nanospectroscopy, *in situ*

Green hydrogen, produced from light energy and water, is a promising renewable fuel for storing electrical energy and a key feedstock in industry (chemicals, metallurgy, steelmaking). Oxygen evolution is the rate-limiting reaction in the production of hydrogen by water splitting. Photoelectrochemical catalysts for oxygen evolution should be inexpensive (free of precious metals), active, and stable.

The selected student will study bismuth vanadate ($BiVO_4$) and MoS_2, two promising semiconductors for photoelectrochemical catalysis. Their performance is limited by the recombination of charge carriers (electrons e^- and holes h^+) that fail to reach the reaction site. We use the light emitted by electron–hole recombination (photoluminescence, PL) to locate the sites where these losses occur in $BiVO_4$. By combining PL with an atomic force microscope (AFM), we will be able to locate these sites with ~10 nm precision, a method known as *tip-enhanced photoluminescence* (TEPL). Armed with this new understanding, we will be able to optimize the synthesis and geometry of the catalysts to improve their performance and lifetime.

Planned work for this doctoral project:

A. Synthesis of $BiVO_4$ films and $BiVO_4/MoS_2$ junctions. The selected student will use the $BiVO_4$ synthesis methods developed by the Siaj laboratory[1,2] to fabricate $BiVO_4$ films. As $BiVO_4$ alone is limited, it will then be combined with MoS_2, a 2D material that will enhance catalytic activity.

B. Use of TEPL to quantify charge-carrier recombination at the nanoscale in $BiVO_4$ and $BiVO_4/MoS_2$ junctions.

PhD position in chemistry – UQAM and Université de Sherbrooke

The work carried out in **A** and **B** will create a feedback loop: understanding the charge-recombination mechanisms will provide guidance for synthesizing more active and stable catalysts.

Qualifications:

We are looking for:

- Someone with a master's degree in chemistry, chemical engineering, or a related field (including, but not limited to: materials science, surface science, physics).
- We strongly encourage applications from people with diverse or interdisciplinary backgrounds.
- Experience in photocatalysis or spectroscopy is an asset but is not required. The project will begin with training in the specialized analysis and synthesis techniques used in both laboratories.
- The candidates should show an interest in understanding the surface chemistry of materials, as well as a motivation to use cutting-edge methods to push the boundaries of knowledge.
- Ability to learn and collaborate in an interdisciplinary environment.

Commitment to equity, diversity, and inclusion

We value diversity of backgrounds, experiences, and perspectives. We particularly encourage applications from people belonging to groups historically underrepresented in research, including women, indigenous and racialized persons, persons with disabilities, and people of all gender identities and sexual orientations.

How to apply:

Please send your application to goubert.guillaume@uqam.ca

Items to include in your application:

- CV
- Cover letter (two pages maximum, 12 pt font, single spacing)
- Transcripts for undergraduate and master's degrees
- Contact information for two relevant references

Applications will be assessed fairly, taking into account diversity of backgrounds and opportunities.

References:

(1) Peng, Z.; Su, Y.; Ennaji, I.; Khojastehnezhad, A.; Siaj, M. *Chem. Eng. J.* **2023**, *477*, 147082. https://doi.org/10.1016/j.cej.2023.147082.

(2) Su, Y.; Peng, Z.; Imane, E.-N.; Liu, P.; Khojastehnezhad, A.; Claverie, J.; Siaj, M. *ACS Appl. Nano Mater.* **2025**, *8* (29), 14689–14702. https://doi.org/10.1021/acsanm.5c02332.