

**Título do curso: Fundamental of solid-state chemistry**

Docente: Adam Duong, Professor *Université du Québec à Trois-Rivières*,  
Canada

Carga horária: 12h

Idioma: inglês

Data: 17, 18 e 19/09, das 14h00 às 18h00

Sala S306-1, bloco A

**Descrição:**

Visão geral sobre os princípios de operação, sobre como entender os espectros dos métodos mais importantes na análise de materiais de estado sólido: difração de raios-X (XRD), infravermelho (IR) e análise térmica. Este curso também fornece conhecimento sobre microscopia eletrônica de varredura (MEV) para analisar a morfologia da superfície do material.

**Ementa:**

O programa será baseado em sete temas principais:

1. Introdução à química do estado sólido;
2. Espectroscopia de infravermelho;
3. Difração de raios-X de monocristais;
4. Difração de raios-X de amostras em pó;
5. Análise térmica;
6. Microscopia eletrônica de varredura;
7. Síntese e caracterização de materiais porosos para aplicações em energia e nanotecnologia;



Adam Duong, Ph.D  
3230 rue St-Marguerite  
Trois-Rivieres, QC, Canada  
G8Z 1W4

✉ adam.duong@uqtr.ca  
☎ 819.376.5011, poste 3570  
🌐 [www.duonglab.ca](http://www.duonglab.ca)  
🌐 <https://www.facebook.com/ScienceDuongLab/notifications/>  
Minorité visible

Member of the IRH et CQMF/CSACS (*Beneficiary of the NSERC-discovery*)

## 1. PROFESSIONAL EXPERIENCE



**Université du Québec à Trois-Rivières, Professor, Canada**

**Current**

Research Topic: Design, synthesis and characterization of materials for the development in energy and nanotechnology

### Fall courses

- CHM1009 : Training in industry
- CIQ1002 : Advanced inorganic II
- SCP1001 : Project graduation

**Course out of campus:** CQMF/CSACS course

### Winter courses

- CIQ1001 : Inorganic chemistry I
- CPH1003 : Electrochimistry
- CPH1016 : State of matter : gas, liquid and solid
- COR1004 : Organic chemistry experimental I
- CPH6009: Synthesis and Characterizations

The statistic at the UQTR in 2017 has class one of my course evaluation 1<sup>st</sup> rank/184



**Université d'Aix-Marseille, ATER (Dr. M. Réglie), France**

**2013-2014**

Research Topic: Biomimetic and bioinspired models of hydrogenases, design of dinuclear peptidic [Ru-Ni] for hydrogen production.

### Classroom courses

- Organic chemistry: (licence 1/biology)
- Inorganic chemistry:(licence2/MPCI, master 1/chemistry)
- Chemistry for biology 2: (licence 1/biology)

### Laboratory courses

- Inorganic chemistry: (licence 2/MPCI, master 1/chemistry)
- Inorganic chemistry: (licence 3/physical chemistry)
- Chimistry 2: (licence 1/ physical chemistry/biology)



**Lawrence Berkeley National Laboratory, Postdoctorat (Prof. O. M. Yaghi), USA**

**2012-2013**

Research topic: Preparation of extended frameworks for applications in materials science and energy storage



**University of California Los Angeles, Postdoctorat (Prof. O. M. Yaghi), USA**

**2011-2012**

Research topic: Design and preparation of novel organic building units to create new COFs with controllable pore sizes



**Université de Montréal, Doctorat (Prof. J. D. Wuest), Canada**

**2005-2011**

Research topic: Design, synthesis and structures of 3D and 2D supramolecular networks held together by a combination of coordinative bonds and other intermolecular interactions

### Classroom courses

- CHM1302 : Organic chemistry 1
- CHM1982 : Organic chemistry 2

### Laboratory courses

- CHM1502/CHM1501 : Experimental chemistry
- CHM1979/CHM2979 : Chemistry for biochemist



**Université Louis Pasteur, DEA (Dr. D. Mandon), France**

**2000-2004**

Research Topic: Design, synthesis and structure of complexes based on the first row of transition metals for environment protection: potential strategy for water treatment



**Centre de traumatologie et d'orthopédie, Stage d'IUT (Dr. G. Férard), France**

**2000**

Research Topic: Blood analysis in biomedical laboratory in collaboration with hospitals

## 2. STUDENT SUPERVISION

### Indirect Funding : \$ 318 265

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|--|----------------|
| • Nour Dissem : Ph. D, energy science and materials, UQTR  | <b>Current</b> |
| • Sanil Rajak : Ph. D, energy science and materials, UQTR, <i>QES</i> (\$124 305)                | <b>Current</b> |
| • Midhun Mohan : Ph. D, energy science and materials, UQTR, <i>QES</i> (\$124 305)               | <b>Current</b> |
| • Arthur F. Sbardelotto: Master, materials engineering, Brazil, <i>Mitacs Globalink</i> (\$3500) | <b>Current</b> |
| • Mohamed El-Hamdani : Master, materials engineering, Université de Bourgogne, France            | <b>Current</b> |
| • Sarah Zaye : IUT in chemistry, Paul Sabatier, France, <i>AMIE</i> (\$3840)                     | <b>Current</b> |
| • Pauline Bélières : IUT de chemistry, Paul Sabatier, France, <i>AMIE</i> (\$3840)               | <b>Current</b> |

• Alexandre. A. Tremblay: Bachelor in chemistry, UQTR	<b>Current</b>
• Kariane Larocque : Bachelor in chemistry, forensic profile, UQTR	<b>Current</b>
• Alfonso Nieto Argüello: Bachelor in chemistry, ITESM, Mexico, <i>Mitacs Globalink</i> (\$3500)	<b>2017</b>
• Margot Lefevre : IUT in chemistry, Paul Sabatier, France, <i>AMIE</i> (\$3840)	<b>2017</b>
• Hugo Gajardoni De Lemos : Ph. D, materials engineering, UFABC, Brazil, <i>PFLA</i> (\$9700)	<b>2016-2017</b>
• Aneeshma Peter : Ph. D, energy science and materials, UQTR, <i>QES</i> (\$41435)	<b>2016-2017</b>
• Patrick Gagnon: Bachelor in chemistry, UQTR	<b>2015</b>

### 3. DIPLOMA

<b>Université de Montréal; Montréal, Québec, Canada</b> (superviseur: Prof. J. D. Wuest)	
<b>Ph.D. in organic chemistry</b>	<b>2011</b>
<b>Université Louis Pasteur; Strasbourg, Bas-Rhin, France</b> (superviseur: Dr. D. Mandon)	
<b>DEA in Transition Metal Chemistry and Molecular Engineering</b>	<b>2004</b>
<b>Université Louis Pasteur; Strasbourg, Bas-Rhin, France</b> (superviseur: Dr. D. Mandon)	
<b>Master in chemistry</b>	<b>2003</b>
<b>Université Louis Pasteur; Strasbourg, Bas-Rhin, France</b>	
<b>Licence in chemistry</b>	<b>2002</b>
<b>Université Louis Pasteur; Strasbourg, Bas-Rhin, France</b>	
<b>DEUG in chemistry</b>	<b>2001</b>
<b>Institut Robert Schuman; Illkirch, Bas-Rhin, France</b>	
<b>Technical diploma in chemistry</b>	<b>2000</b>

### 4. PUBLICATION

- Rajak, S.; Mohan, M.; A. Tremblay, A.; Maris, T.; Santos, S. L. D.; Venancio, E. C.; Ferreira Santos, S.; **Duong, A\***. "Molecular Ordered Materials: Driving the Self-Assembly by Coordination and Hydrogen bonds of 6-(Pyridin-2-yl)-1,3,5-triazine-2,4-diamine with  $M(NO_3)_2$  Salts". *ACS Omega*, **2019**, 4(2), 2708.
- Mohan, M.; Rajak, S.; A. Tremblay, A.; Maris, T.; **Duong, A\***. "Syntheses of Mono and Bimetallic Cyamelurate Polymers: Single-Crystal Structure and Reversible Chromic Behaviour". *Dalton Trans*, **2019**, doi.org/10.1039/C9DT01278H.
- Duong, A\***, Rajak, S.; A. Tremblay, A.; Maris, T.; Wuest, J. D. "Molecular Organization in Crystals of Bis(diaminotriazinyl)-Substituted Derivatives of Benzene, Pyridine, and Pyrazine" *Cryst. Growth Des.* **2019**, 19(2), 1299.
- Peter, A.; Mohan, M.; Maris, T.; Wuest, J. D.; **Duong, A\***. "Comparing Crystallizations in 3D and 2D: Behavior of Isomers of [2,2'-Bipyridine]dicarbonitrile and [1,10-Phenantroline]dicarbonitrile." *Cryst. Growth Des.* **2017**, 17(10), 5242.
- Peter, A.; Mohan, M.; Maris, T.; Wuest, J. D.; **Duong, A.** "Comparing Crystallizations in 3D and 2D: Behavior of Isomers of [2,2'-Bipyridine]dicarbonitrile and [1,10-Phenantroline]dicarbonitrile." *Cryst. Growth Des.* **2017**, 17(10), 5242.
- Pal, A. K.; **Duong, A.**; Wuest, James. D.; Hanan, G. S. "Long-lived, red-emitting excited state of a Ru(II) complex of a diaminotriazine ligand." *Polyhedron*. **2016**, 108, 100.
- Zhang, Y.-B.; Su, J.; Furukawa, H.; Yun, Yifeng.; Gándara, Felipe.; **Duong, A.**; Zou, X.; Yaghi, O.M. "Single-Crystal Structure of a Covalent Organic Framework". *J. Am. Chem. Soc.*, **2013**, 135(44), 16336.
- Duong, A.**; Maris, T.; Wuest, J. D. "Bis(2,2'-bipyrimidine-[kappa]<sup>2</sup>[N<sup>1</sup>],N<sup>1</sup>[1'])palladium bis(tetrafluoroborate) acetonitrile monosolvate." *Acta Cryst.* **2012**. E68, m1347.
- Duong, A.**; Dubois, M.-A.; Wuest, J. D. "2D Molecular Organization of Pyridinecarboxylic Acids Adsorbed on Graphite." *Langmuir*. **2010**, 26(23), 18089-18096.
- Duong, A.**; Maris, T.; Wuest, J. D. "Structural Similarity of Hydrogen-Bonded Networks in Crystals of Isomeric Pyridyl-Substituted Diaminotriazines." *Cryst. Growth Des.* **2011**, 11(1), 287-294.
- Duong, A.**; Maris, T.; Wuest, J. D. "Syntheses and Structures of Isomeric Diaminotriazinyl Substituted 2,2'-Bipyridines and 1,10-Phenanthrolines." *J. Org. Chem.* **2011**, 76(5), 1333-1341.
- Duong, A.**; Maris, T.; Wuest, J. D. "Engineering Homologous Molecular Organization in 2D and 3D. Cocrystallization of Aminoazines and Alkanecarboxylic Acids." *CrystEngComm*. **2011**, 13, 5571-5577 (**Article cover**).
- Duong, A.**; Dubois, M. -A.; Maris, T.; Métivaud, V.; Yi, J.-H.; Nanci, A.; Rochefort, A.; Wuest, J. D. "Engineering Homologous Molecular Organization in 2D and 3D. Cocrystallization of Pyridyl-Substituted Diaminotriazines with Alkanecarboxylic Acids." *J. Phys. Chem. C*. **2011**, 115(26), 12908-12919.
- Duong, A.**; Maris, T.; Wuest, J. D. "trans-Dichloridobis[(pyridin-4-yl)boronic acid-κN]palladium(II) dimethyl sulfoxide disolvate." *Acta Cryst.* **2011**. E67, m518.
- Duong, A.**; Maris, T.; Wuest, J. D. "Using Pyridinyl-Substituted Diaminotriazines to Bind Pd(II) and Create Metallotectons for Engineering Hydrogen-Bonded Crystals." *Inorg Chem.* **2011**, 50(12), 5605-5618.
- Duong, A.**; Maris, T.; Métivaud, V.; Wuest, J. D. "Surrogates of 2,2'-Bipyridine Designed to Chelate Ag(I) and Create Metallotectons for Engineering Hydrogen-Bonded Crystals." *Cryst. Growth Des.* **2011**, 11(5), 2026-2034.
- Duong, A.** "Contrôle de l'organisation moléculaire en 2D et 3D par l'utilisation de liaisons hydrogène, de coordination métallique et d'autres interactions." *thèse de doctorat*. **2011**

**En soumission:**

18. **Duong, A.**; Maris, T.; Wuest, J. D. “Controlling Molecular Organization by Using Phenyl embraces of Multiple Trityl Groups”.

**5. SCIENTIFIC PRESENTATIONS**

- Duong, A.** “Sustainable and Clean Manufacture of Functional Materials”. Séminaire au département de chimie, Université Strasbourg I, Strasbourg, Alsace, France. (*Invited*, sera le 20 December 2018)
- Duong, A.** “Functional Materials for Energy and Nanotechnology Applications”. The Physics Colloquium series, Concordia University, Montréal, Qc, CA. (*Invited*, sera le 22 October 2018)
- Duong, A.** “The Perspectives of Inorganic vs Organic Chemistry to create new Crystalline Materials”. Symposium Annuel en Chimie Inorganique du Québec, UQTR, Qc, CA. (*Organizer*, august 2018)
- Duong, A.** “Use Only What You Need and Contribute as You Can: Materials Design for Energy and Nanotechnology Applications”. The 5th Crystal Engineering and Emerging Materials Workshop of Ontario and Quebec: Engineering the Solid State for Sustainability and Green Chemistry, McGill, Qc, CA. (*Invited*, July 2018)
- Duong, A.** “Do what you can: energy conservation and materials design”. INRS, Qc, CA. (*Invited*, May 2018)
- Duong, A.** “Materials design for the development of energy and nanotechnology”. Emerging Technologies 2018. Whistler, BC, CA. (*Invited*, May 2018)
- Duong, A.** “What if Graphite Is Already Among the Best Materials”. 1<sup>er</sup> symposium du CQMF/QCAM. Sherbrooke, Qc, CA. (*Invited*, October 2017)
- Duong, A.** “Nitrogen-Rich Ordered 2D Polymers Exhibiting Switchable Properties”. 100<sup>th</sup> Canadian Chemistry Conference and Exhibition. Toronto, On, CA. (June 2017)
- Duong, A.** “From single molecule to materials for development in nanotechnology and energy applications”. Colloque du Crépec. Montréal, Qc, CA. (*Invited*, June 2017)
- Duong, A.** “Development of Pyridone Based Metal-Organic Frameworks for Gas Storage Applications”. Engineering Undergraduate Programs' Week. Université Fédérale de l'ABC. Sao Carlos, SP, Brazil. (*Invited*, October 2016)
- Duong, A.** “Synthesis of Hydrogen-Bonded Organic Frameworks, Metal-Organic Frameworks and Covalent Organic Frameworks for Sustainable Energy”. 8<sup>e</sup> Colloque annuel du Centre Québécois sur les Matériaux Fonctionnels. Drummondville, QC, CA. (*Invited*, November 2015)
- Duong, A.** “From single molecule to materials for development in nanotechnology and energy applications”. 98<sup>th</sup> Canadian Chemistry Conference and Exhibition. Ottawa, On, CA. (*Invited*, June 2015)
- Duong, A.** Entrevue avec Mme Brigitte Trahan, journaliste au journal Le Nouvelliste. “Le secret de l'énergie de demain”, Le Nouvelliste. Trois-Rivières, Qc, CA. (November 2015)
- Duong, A.** Entrevue avec M. Pierre Pinsonnault, rédacteur du service des communications de l'UQTR, “Conversion et stockage de l'énergie, créer des matériaux intelligents”, dans Connexion UQTR. Trois-Rivières, Qc, CA. (November 2016)
- Duong, A.** “Molecular Tectonic and Reticular Chemistry: Strategies for Building Predictable Ordered Architectures”. Halifax, N.-É, CA. (*Invited*, May 2013)
- Duong, A.** “Nucleophilic substitution  $SN_1$  and  $SN_2$ ”. Cours magistral, Halifax, N.-É, Canada. (*Invited*, May 2013)
- Duong, A.**; Maris, T.; Wuest, J. D. “Constructing Molecular Networks From Metallotectons”. 94<sup>th</sup> Canadian Chemistry Conference and Exhibition, Montréal, Qc, CA. (June 2011)
- Duong, A.**; Maris, T.; Wuest, J. D. “Learning About Molecular Association by Comparing the 2D and 3D Crystallization and Co-Crystallization of Aminotriazines”. 93<sup>rd</sup> Canadian Chemistry Conference and Exhibition, Toronto, On, CA (May 2011)

**6. INVOLVEMENT IN THE ORGANIZATION OF SCIENTIFIC EVENT**

<b>2018</b>	Organizer member of the Symposium Annuel de Chimie Inorganique du Québec, Trois-Rivières, Qc, CA.
<b>2017</b>	Organizer member of the symposium et chair of session “Materials for energy conversion and storage”, XVI Brazil-MRS Meeting – SBPMat, Gramado, Rio Grande do Sul, Brazil
<b>2017</b>	Chair of session “Self-assembly” lors du 10 <sup>ème</sup> colloque du CQMF/, Université de Sherbrooke, Sherbrooke, Qc, CA
<b>2016</b>	Organizer member of the symposium et chair de session “Materials for energy conversion and storage”, XV Brazil-MRS Meeting – SBPMat, Campinas, Sao Paulo, Brazil
<b>2015-2018</b>	President of the jury of the 22 <sup>e</sup> , 23 <sup>e</sup> , 24 <sup>e</sup> et 25 <sup>e</sup> poster competition at UQTR, Trois-Rivières, Qc, CA
<b>2015</b>	Chair of session “Energy” lors du 8 <sup>e</sup> colloque du CQMF, Hôtel Le Dauphin, Drummondville, Qc, CA

**7. SCIENTIFIC MANAGEMENT**

<b>2018-2021</b>	Director of CPCS - Physique et sciences de l'énergie et des matériaux
<b>2017-2019</b>	Membre of the executive committee of the département de chimie, biochimie et physique-UQTR
<b>2017-2019</b>	Member of the committee of biosecurity and hazardous materials management
<b>2018</b>	President of the jury of doctoral exam, Viney Dixit, “Study of the effect of Zr and Zr <sub>7</sub> Ni <sub>10</sub> addition on hydrogen storage behavior of Ti-V-Cr alloys”, UQTR
<b>2017-2018</b>	Member of the committee of CPCS - Physique et sciences de l'énergie et des matériaux
<b>2017</b>	Member of the committee for the selection of a professor in vegetal biotechnology (poste E0254, prise 2)

- 2017** President of the jury of doctorat, François Martel, “*Gestion optimale d’énergie de véhicules électriques hybrides incluant la dégradation de leurs vecteurs énergétiques*”, UQTR
- 2017** President of the jury of doctoral exam, Abhishek K. Patil, “*Effect of mechanical deformations and annealing on hydrogen properties of doped BCC alloys*”, UQTR
- 2017** President of the jury of doctoral exam, Ali Amamou, “*Stratégie adaptative pour le démarrage à froid des véhicules à pile à combustible*”, UQTR
- 2017** Member of the jury of the master, Ryan Richard, “*Développement de nouveaux catalyseurs pour la réaction de Huisgen et l’amination réductrice*”, Université de Moncton
- 2016** Member of the jury of the master, Guillaume Nourry, “*Étude des contraintes physico-chimiques reliées à la synthèse de fibres kraft propargylées et hydrophobisation de fibres kraft phosphorylées*”, UQTR
- 2016** Member of the committee for the selection of a professor in vegetal biotechnology (poste E0254)
- 2015** Membre du jury d’évaluation de la thèse de maîtrise de Julie Bruneau, “*Synthèse de prolines quaternaires et de diénamides : étude méthodologique des couplages au cuivre et de la réaction de Heck*”, UQTR