

# MOLECULAR AND BIOLOGICAL CHEMISTRY

MASTER

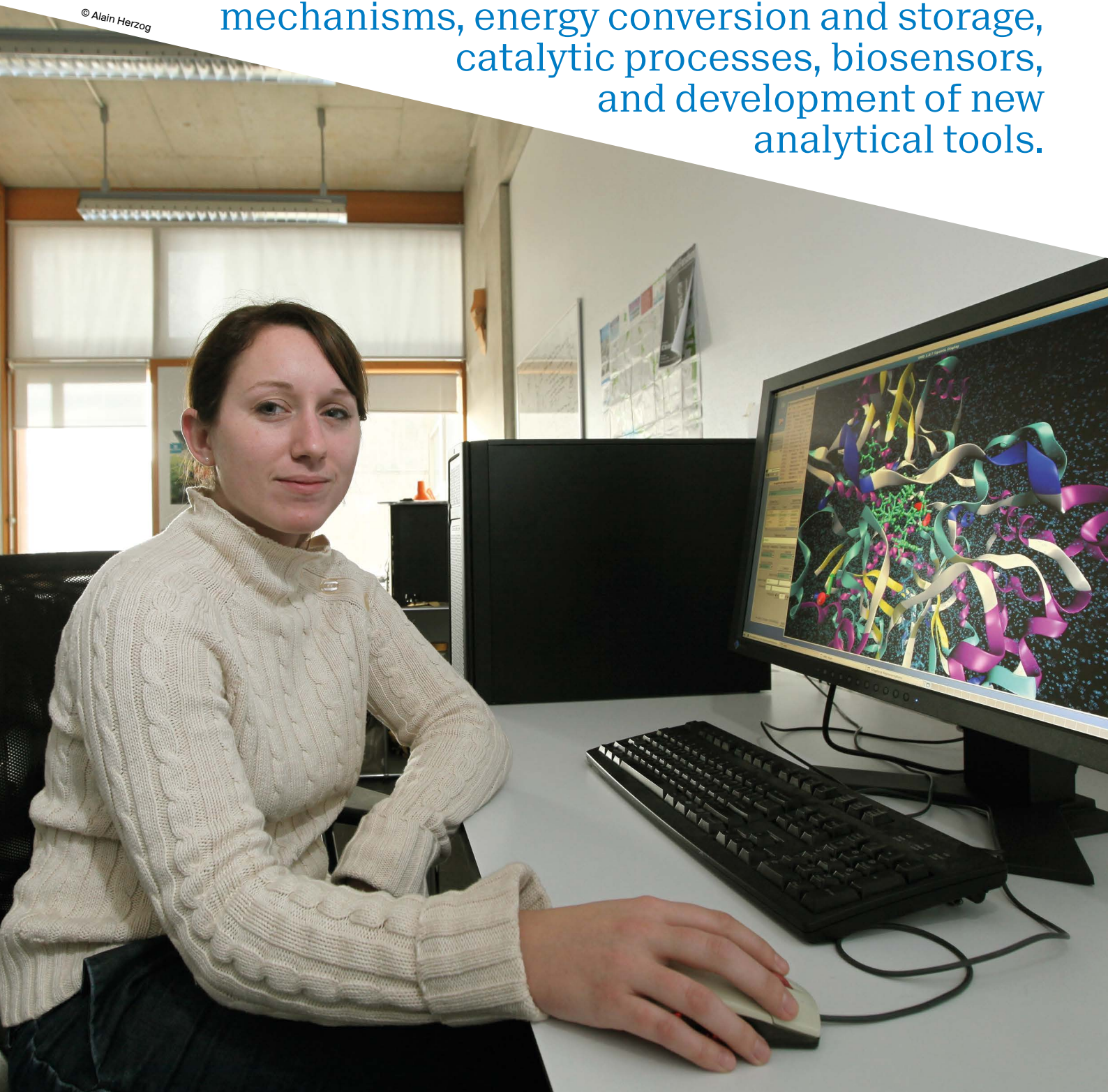
EPFL

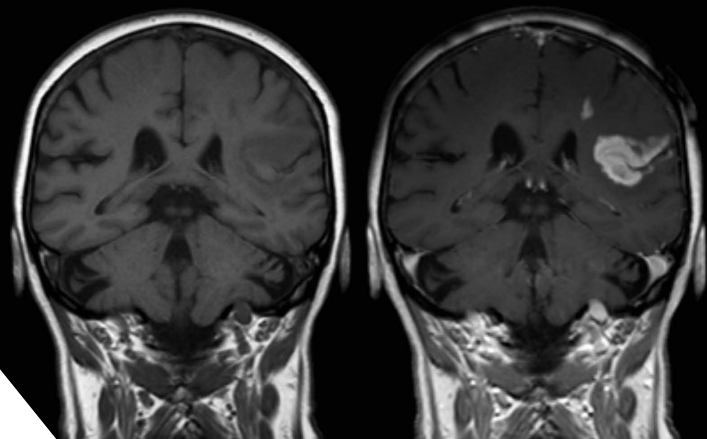


## Molecules for Life and for Energy

Modern science is continuously leaning towards Chemistry. In Life Sciences, Materials or Environment, researchers realize that pertinent answers are hidden at the molecular scale. Amongst more than 30 research groups, our key activities aim to progress in fine molecules with biological interests, understanding of biological mechanisms, energy conversion and storage, catalytic processes, biosensors, and development of new analytical tools.

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**Mélanie Zeller:**  
*"This Master's degree offers a broad choice of courses in the main areas of chemistry. I discovered medicinal chemistry, a topic I'm very interested in and specifically research against cancer. I will realize my Master project with an EPFL professor who works in the field of biomolecular imaging. This Master is more oriented toward research and I'm thinking about doing a PhD."*

## Oligoprolines as MRI Contrast Agents - A Preliminary Study

Gaëlle Lopicorey

Magnetic resonance imaging (MRI) is an indispensable non-invasive clinical tool allowing 3D images of the body with high spatial resolution.

It makes use of the property of nuclear magnetic resonance to image the nuclei of atoms inside the body. Contrast agents improve the contrast and the sensitivity using paramagnetic species as gadolinium. The contrast of the MRI image depends on the variation of relaxation for different tissues. Efficiency of contrast agents is measured in terms of relaxivity.

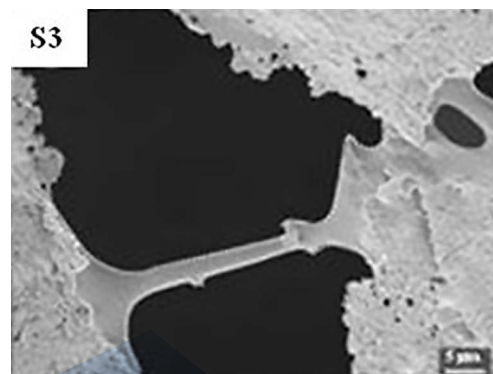
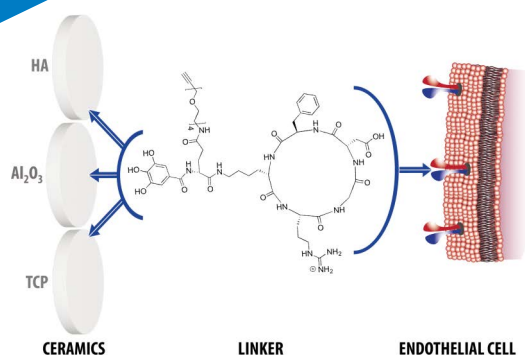
The aim of this project was to determine the relaxivities of two complexes of gadolinium composed of long rigid oligoprolines and gadolinium chelates of the common DOTA type. The oligoprolines are in this case composed of 19 or 20 single prolines which are amino acids present in humans. The two compounds differ only by the place where the chelate is fixed: For the first compound, it is fixed on the first proline of the chain whereas for the second one it is fixed on the middle of the chain. This different way of fixation will sense the motion of the rigid, stick-like molecule in different ways. This will help to design new and more efficient contrast agents in future.

## Towards the Functionalization of Bioceramics for the Development of Bone Implants

Stéphanie Prior

This work aims to synthesize multi-functional ligands for surface modification of new synthetic bone scaffolds for synthetic grafts. They all have to be porous to match the bone's composition, can be made in diverse shapes and physical properties, and some can be resorbable, so that the bone remodelling will slowly replace the graft.

Depending on the patient's situation, permanent implants are also investigated. Ceramics bone implant matches all of those criteria.



Cell adhesion to porous biomaterials

Watch the video:

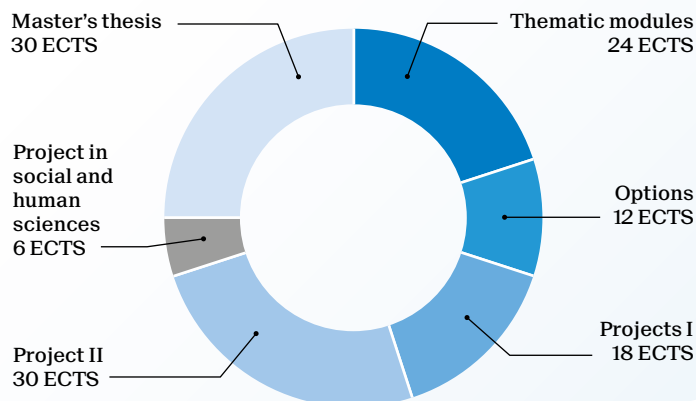


**Aleksandar Salim:**  
*"You can apply your knowledge everywhere. And it is fun! I take it as a game. Imagine yourself doing some problem solving, puzzling, all the time."*



# Master of Science in MOLECULAR AND BIOLOGICAL CHEMISTRY

2-year program - 120 ECTS



## Thematic modules and catalysis/sustainability specialization

Students must choose 3 thematic modules. They may opt for a 30 ECTS catalysis/sustainability specialization. In this case, the sustainability module is mandatory and 16 ECTS of the specialization labeled courses must be taken on top of the project in molecular sciences Ia.

	Spec.	Credits
<b>Options</b>		
<b>Catalysis</b>		
Advanced nuclear magnetic resonance	●	3
Bioprocesses and downstream processing	●	4
Biotechnology lab (for CGC)	●	4
Catalysis for emission control and energy processes	●	3
Electrochemical engineering	●	3
Heterogeneous reaction engineering	●	4
<b>Sustainability</b>		
Environmental Economics	●	4
Environmental system analysis and assessment	●	5
Fate and behaviour of environmental contaminants	●	4
Introduction to ethics and critical thinking	●	3
Legal aspect of sustainability & digitalization	●	5
Process intensification and green chemistry	●	3
Safety of chemical processes	●	2
Science of climate change	●	4
Sustainability and materials	●	3

Students may also opt for a 30 ECTS minor instead of the project in molecular sciences II.

Recommended minors:

- Materials science and engineering
- Physics

	Spec.	Credits
<b>Thematic modules</b>		<b>24</b>
<b>Analytical and bioanalytical chemistry</b>		<b>8</b>
Methods in drug development		3
Physical and chemical analyses of materials	●	3
Protein mass spectrometry and proteomics		2
<b>Biological chemistry and biophysics</b>		<b>8</b>
Cellular signaling		2
Frontiers in chemical biology		3
Nanobiotechnology and biophysics		3
<b>Computational chemistry</b>		<b>8</b>
Computational methods in molecular quantum mechanics		4
Understanding advanced molecular simulation		4
<b>Inorganic chemistry</b>		<b>8</b>
Catalysis for energy storage	●	3
Catalyst design for synthesis	●	2
Solid state chemistry and energy applications		3
<b>Organic chemistry</b>		<b>8</b>
Physical and computational organic chemistry		2
Structure and reactivity		3
Total synthesis of natural products		3
<b>Physical chemistry</b>		<b>8</b>
Molecular quantum dynamics		3
Optical methods in chemistry	●	3
Photochemistry I		2
<b>Sustainability</b>		<b>8</b>
Automated and data-driven laboratories	●	2
Sustainable chemicals manufacture: concepts/tools	●	4
Sustainable chemistry and engineering in industry	●	2
<b>Options</b>		<b>12</b>
<b>Molecular and supramolecular science</b>		
Artificial photosynthesis		2
Asymmetric catalysis for fine chemicals synthesis	●	3
Chemistry of f elements		2
Supramolecular chemistry		2
<b>Physical and analytical chemistry</b>		
AI for chemistry	●	2
Fundamentals of biosensors and electronic biochips		3
Machine learning for physicists	●	4
Molecular spectroscopy in chemistry		2
Photomedicine		2
<b>Material science</b>		
Nanomaterials		3
Organic electronic materials		4
Physical chemistry of polymeric materials		3
Polymer chemistry and macromolecular engineering		3
<b>Food science</b>		
Chemistry of food processes		2
Chimie des denrées alimentaires		2
Risk management	●	2
<b>Projects I</b>		<b>18</b>
Project in molecular sciences Ia	●	6
Project in molecular sciences Ib		12

School of Basic Sciences  
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