



Graduate Programs in Engineering

at the University of Alberta

MSc
PhD
MEng



Advanced Fuel Cells Aerosols and Particle Dynamics Biochemical Engineering Biomechanics Biomedical Engineering
Carbon Capture and Storage Catalysis and Reaction Engineering Colloids Communications Computational Intelligence
Computer Engineering Construction Engineering and Management Corrosion and Wear Drug and Gene Delivery
Electronic Materials and Devices Energy and the Environment Energy Systems Engineering Management Environmental
Engineering Environmental Remediation Fluid Dynamics Geostatistics Geotechnical Engineering Information and
Communications Technologies Integrated Circuits Interfacial Engineering Magnetic Resonance Imaging (MRI) Material
Processing Mathematical Modeling Metamaterials Micro- and Nano-Electromechanical Systems Micro- and Nanofluidic
Mineral Processing Mining Engineering Molecular Sieves Nanoelectronics Nanofabrication Nanotechnology
Non-Aqueous Bitumen Extraction Oil Sands Tailings Oil Sands Upgrading Petroleum Engineering Petroleum
Thermodynamics Photonics and Electromagnetics Pipelines and Pipeline Transport Plasmas Polymer Engineering

RESEARCH STRENGTHS

Power Electronics and System
Process Control Rail Hazard
and Safety Renewable Energy Robotics Safety and Risk Management Signal and Image Processing Smart Grid
Software Engineering Solid Mechanics Structural Engineering Synthetic Biology Systems and Control System
Biology Tailings Management Thermal Conversion Thermodynamics Thermo-fluids Transportation Engineering
Unconventional Oil Recovery Water Quality Management Water Resources Welding and Joining Wireless System
Advanced Fuel Cells Aerosols and Particle Dynamics Biochemical Engineering Biomechanics Biomedical Engineering
Carbon Capture and Storage Catalysis and Reaction Engineering Colloids Communications Computational Intelligence
Computer Engineering Construction Engineering and Management Corrosion and Wear Drug and Gene Delivery
Electronic Materials and Devices Energy and the Environment Energy Systems Engineering Management Environmental
Engineering Environmental Remediation Fluid Dynamics Geostatistics Geotechnical Engineering Information and
Communications Technologies Integrated Circuits Interfacial Engineering Magnetic Resonance Imaging (MRI) Material
Processing Mathematical Modeling Metamaterials Micro- and Nano-Electromechanical Systems Micro- and Nano-fluidic



Where do you want to go as an engineer?

Graduate school is an investment in your future. In fact, it can make all the difference in the trajectory of your career. An advanced degree is the first step on a career path to leadership positions in technology companies, consulting, research and development organizations, advanced design houses, government, policy development, and academia. Your advanced engineering degree will open doors to exciting challenges as well as professional and personal satisfaction.

The benefits of pursuing graduate studies in the Faculty of Engineering at the University of Alberta

Our students have chosen to make that investment and pursue postgraduate education. They have plans for their careers, and high expectations of their chosen school.

This is what our students say they appreciate most in the Faculty of Engineering:

- Acquiring technical, problem solving, professional development, and communication skills critical for the work force.
- Working with highly respected faculty members who publish in prestigious journals and collaborate with international leaders.
- Interacting directly with industry partners, bridging industry and academia and building their professional networks.
- Collaborating on- and off-campus with world leaders in multidisciplinary projects.
- Using state-of-the-art facilities, including world-class resources for nanofabrication, high performance computing, magnetic resonance imaging, patient rehabilitation and surface characterization.
- Having access to significant research funding (greater than \$50M per year) and student financial support (\$19M per year).
- Feeling welcomed, safe, and supported in the University of Alberta and Edmonton communities.

These are the underpinnings of the graduate experience awaiting you in the Faculty of Engineering at the University of Alberta.

Greeting innovation with open arms

Katherine Evans (BSc 13) is helping to design a tactor system that will give upper-limb amputees the sensation of feeling in their prostheses, allowing them to control their artificial limbs intuitively rather than consciously. Katherine, who is just beginning her MSc under the supervision of Dr. Jason Carey in the Department of Mechanical Engineering and Dr. Jacqueline Hebert in the Division of Physical Medicine and Rehabilitation, will be a member of the interdisciplinary BLINC (Bionic Limbs for Improved Natural Control) project. Through BLINC, experts in rehabilitation medicine, computer science and mechanical engineering are combining surgical rearrangement of existing nerves with innovative myoelectric devices to improve prosthetic function.

Katherine will be building on her significant undergraduate research experience thanks to scholarships from Alberta Innovates – Technology Futures and the Natural Sciences and Engineering Research Council of Canada (NSERC). She has already assisted in the testing of internal composite casts to stabilize broken bones as an NSERC summer student, built an ultrasound-enhanced tipping table for the treatment of scoliosis at the Glenrose Rehabilitation Hospital as a co-op student, and launched a sounding rocket (at the University of Oslo) through the CaNoRock program.

Katherine has chosen to remain in the U of A's Faculty of Engineering for her MSc because she's "not ready to leave the people, resources and interdisciplinary collaborations - yet."

Katherine's enthusiasm is infectious. "My main goal is to be a professor," she says. "I'm really motivated by the opportunity to mentor younger students."





The Faculty of Engineering at the University of Alberta

Established in 1908, the Faculty of Engineering ranks in the top five per cent of more than 400 engineering schools in North America. This vibrant community of scholars conducts basic and applied research, collaborating extensively with industry and leading international partners. Research conducted here has made Alberta a world leader in a wide variety of fields ranging from oil sands technologies to nanotechnology.

Students in our PhD, MSc and MEng programs will join the largest graduate engineering program in Canada, working with world-renowned scholars who attract over \$50M in research funding annually. Graduate programs

are offered in five departments: Biomedical Engineering, Chemical and Materials Engineering, Civil and Environmental Engineering, Electrical and Computer Engineering and Mechanical Engineering.

Students have the opportunity to work with outstanding faculty (including more than 30 internationally recognized NSERC Industrial Research Chairs and Canada Research Chairs) in state-of-the-art facilities. Since 2001, the Faculty of Engineering has added over one million square feet of new teaching and research space, creating exceptional opportunities for collaboration, learning, professional growth and interdisciplinary research.

Katherine Evans (left) is excited to start her first graduate-level teaching assignment this fall, and plans to someday teach engineering design. Meanwhile, she will be continuing to supervise high-school students in the WISEST (Women in Scholarship, Engineering, Science and Technology) Summer Research Program and to contribute biomedical content to DiscoverE, the Faculty of Engineering's Engineering, Science and Technology outreach program.

Key Research Facilities

THE NANOFAB An open access micro and nano fabrication research facility with approximately \$60 M worth of state-of-the-art fabrication equipment and infrastructure (www.nanofab.ualberta.ca).

THE NATIONAL INSTITUTE FOR NANOTECHNOLOGY (NINT) A joint venture with the National Research Council Canada (NRC) that hosts world-leading facilities and research programs involving more than 300 researchers (www.nint.ualberta.ca).

THE ALBERTA CENTRE FOR SURFACE ENGINEERING AND SCIENCE (ACES) A \$20M multi-disciplinary integrated surface characterization and modification facility (www.ualberta.ca/ACES).

THE OIL SANDS TAILINGS RESEARCH FACILITY A facility designed to support substantial fundamental tailings research at a pilot scale (600 and 2000 kg solids per hour) and accommodate multiple, concurrent interdisciplinary research projects (www.ostrf.com).

THE PETER S. ALLEN MAGNETIC RESONANCE RESEARCH CENTRE A 100 per cent research dedicated, state-of-the-art facility located inside the University Hospital that houses 1.5 T, 3 T and 4.7 T full-body MRI systems (www.invivonmr.ualberta.ca).

WESTGRID A Western Canadian consortium of high-performance computing facilities, including machines with some of the fastest computational speeds in Canada (www.westgrid.ca).

Faculty of Engineering

Key Research Initiatives

INGENUITY The Nanotechnology Accelerator - A large scale (\$100M), 10-year, multidisciplinary research and development initiative co-located at the University of Alberta, the Faculty of Engineering and the National Institute for Technology. Ingenuity is focused on groundbreaking bionanotechnology advances and innovative business practices that will enable Alberta to become a world-leading centre for nanotechnology innovation (www.thepowerofn.ca).

THE CENTRE FOR OIL SANDS INNOVATION (COSI) A \$50M dollar, multidisciplinary research centre focused on developing the oil sands production facility of the future - one that uses little or no water, consumes less energy, occupies less area, integrates upgrading operations and costs less to build and operate (www.cosi.ualberta.ca).

THE CANADIAN CENTRE FOR CLEAN COAL/CARBON AND MINERAL PROCESSING TECHNOLOGIES (C5MPT)

A research and education centre supporting sustainable and responsible energy and mineral development (www.c5mpt.ualberta.ca).

THE HELMHOLTZ-ALBERTA INITIATIVE (HAI)

An international research partnership between the Helmholtz Association of German Research Centres (Germany) and the University of Alberta (Canada) to jointly develop solutions to major challenges in fields such as energy and the environment, ecosystem and resource informatics, and health (www.helmholtzalberta.ca).

SINO-CANADIAN ENERGY AND ENVIRONMENT RESEARCH AND EDUCATION INITIATIVE (SCENEREI)

A partnership that brings together the University of Alberta and the Tsinghua University as partners in contributing through research, and subsequent development of innovative and efficient



technologies, aiming to address global issues on energy and the environment.

WATER INITIATIVE The University of Alberta Water Initiative brings together researchers from across campus to participate in multi-disciplinary water projects. The researchers are from engineering, nanotechnology, public health, environmental and natural resource economics, law and business and scientists in biology, chemistry, geology and hydrology all working on water related issues. The multi-disciplinary approach is enabled by the University of Alberta's extensive water research capacity.

Zhen Lei (right) is mentored by Dr. Mohamed Al-Hussein, a member of the Hole School of Construction Engineering, which emphasizes industry-oriented graduate student research in the management, industrialization, and strategic modeling of construction. Industry-funded research programs and interdisciplinary collaborations ranging from business to architecture to mathematics combine to create exceptional learning and networking opportunities for graduate students.



Taking on the heavy lifting

Zhen Lei (BSc 09, MSc 11) is developing an automated approach to crane path planning for heavy industry, including the ongoing module-based construction in Alberta's oil sands. Supervised by Dr. Mohamed Al-Hussein (NSERC Industrial Research Chair in the Industrialization of Building Construction) and working closely with PCL Industrial Management Inc., Lei is replacing a tedious and error-prone manual process for lift planning with an automated calculation and visualization methodology. In the words of one industry insider, this project is "taking the construction industry from the 19th to the 21st century."

As a PhD student in the Department of Civil and Environmental Engineering, Lei has benefitted from working with multiple companies in Canada and Germany over the course of his research.

"There is no question in my mind that my post-graduate experience will put me on the fast track to success and leadership in industry," says Lei.

Lei has been a leader in graduate student government since his arrival from China in 2009. Most recently, Lei was the VP Academic for the Faculty of Engineering Graduate Research Symposium. This annual, student-run event features professional development workshops, high-profile invited speakers and more than 100 interdisciplinary presentations from graduate students in all five engineering departments. For students, this event is an opportunity to meet their peers in other departments and broaden their knowledge base.

MSc

Graduate Programs in Engineering

PhD

All five Faculty of Engineering departments offer MSc and PhD programs

The **MASTER OF SCIENCE (MSc)** is a full-time, research-based degree requiring the completion of a thesis. As an MSc student, you will concentrate on one area of study, developing more advanced skills and knowledge that will benefit you as you enter or re-enter industry.

The **DOCTOR OF PHILOSOPHY (PhD)** is a rigorous, research-oriented degree requiring the completion of a thesis. Taking specialization to the next level, this program builds on your analytical skills and leads to careers in academia or corporate research and development.

Other post-graduate program options


The **MASTER OF ENGINEERING (MENG)** is a course-based degree intended for the working professional and foreign-trained professionals interested in becoming familiar with North American industry. Course content is more applied than in thesis-based MSc and PhD programs and is typically delivered in formats designed to better accommodate working professionals.

The **ENGINEERING MANAGEMENT MENG, MSc AND PhD DEGREES** provide unique graduate opportunities that allow you to broaden your management knowledge and expertise for leadership in technical organizations. Many courses are offered during evening hours to better accommodate working professionals.

The **MBA/MENG** combines advanced engineering knowledge with managerial skills for a competitive advantage in the global marketplace. Students study the key areas of business in Year One and focus on graduate-level courses within the student's engineering discipline in Year Two. An engineering project and a business strategy course complete the program requirements. This degree program is offered jointly with the Alberta School of Business.

The **MASTER OF SCIENCE IN INTERNETWORKING (MINT)** is a two year course-based degree focused on Internetworking leadership training. Course content addresses both theoretical (academic) and practical aspects of Internetworking in intensive weekend sessions to better accommodate working professionals. This degree program is offered jointly by the Departments of Electrical and Computer Engineering and Computing Science.

The **MD-PHD PROGRAM** allows you to earn both MD and PhD degrees, preparing you for a career as a medical research scientist. To be accepted into this program, you must have already been accepted into the MD Program, and have the approval of the MD/PhD Committee. This combined degree program is offered jointly by Biomedical Engineering and the Faculty of Medicine & Dentistry.



Andrew Walsh (right) believes that access to a dedicated MRI facility offers students the opportunity to make significant discoveries and innovations. "Having almost unlimited access to the MRI systems means individual students can take an idea and move it from development to verification to patient application."



Engineering better patient outcomes

With one foot planted in the world of engineering and the other in medicine, Andrew Walsh (BSc 08, PhD 13) is poised to become a world leader in medical magnetic resonance imaging (MRI). Andrew, an MD-PhD student, recently completed his PhD in Engineering and has now returned to medical school at the University of Alberta. Combining advanced medical training with advanced scientific knowledge, Andrew plans to make an impact in both research and patient care as a clinician scientist.

“It’s like a positive feedback loop,” he explains. “The synergy between the two sets of knowledge makes you better in both roles.”

Andrew completed his PhD under the supervision of Dr. Alan Wilman in the Department of Biomedical Engineering and was funded by a Vanier Scholarship (Canada’s most prestigious doctoral award). He developed a magnetic resonance imaging (MRI) method to evaluate iron levels in the deep grey matter of the brains of multiple sclerosis (MS) patients. He subsequently found a correlation between high iron levels in these brain areas and the disease’s severity, especially when evaluated longitudinally. Over the long-term, MRI assessment of iron could be used to evaluate MS disease progression and/or treatment effectiveness.

Andrew’s work was facilitated by his having access to the Peter S. Allen MR Research Centre, a 100 per cent research dedicated, state-of-the-art MRI facility at the U of A. Unique within Canada and recently expanded through a \$17.5M grant anchored by the Canada Foundation for Innovation, the facility has three MRI systems for full-body human imaging (field strengths: 1.5 T, 3 T and 4.7 T), all located inside the University Hospital.

Small things lead to big opportunities

Ryan Tucker (BSc 09) hopes to build a greener future for our planet by developing nanostructured electrodes for low cost, high efficiency energy conversion devices. He discovered a method to control the growth of transparent conductive single-crystal nanostructured materials with extremely high surface areas, making them ideal electrodes for next generation optoelectronic devices. This work was completed in the lab of Dr. Michael Brett (Micralyne/NSERC/iCORE Senior Industrial Research Chair, Canada Research Chair and Senior Research Officer with the National Institute for Nanotechnology) and has already resulted in a provisional patent application.

Ryan, a PhD candidate in the Department of Electrical and Computer Engineering with 14 journal publications and a long list of awards (including the Izaak Walton Killam Memorial Scholarship), is convinced that alternative energy technologies can solve the world's energy problems.

"It's completely possible as long as engineers can overcome the manufacturing challenges we face right now." For his part, Ryan intends to continue to contribute to these solutions by pursuing what he loves – inventive research and technology development.

With more than 150 professors and 1400 total interdisciplinary researchers (including 22 Canada Research Chairs, six NSERC industrial Research Chairs and a Canada Excellence Research Chair), the University of Alberta is a destination of choice for graduate students interested in nanotechnology research.



Admission

Admissions Requirements and Deadlines

If you currently hold a degree in Engineering or a related field and plan to apply to a graduate program, please contact the department offering the area of research in which you are interested. Individual departments have different application and entry dates, as well as different application procedures. Students are admitted for both September and January start dates.

For more information on the different graduate programs, visit each department's graduate studies site:

BIOMEDICAL ENGINEERING

www.biomed.engineering.ualberta.ca/en/Graduate.aspx

CHEMICAL AND MATERIALS ENGINEERING

www.cme.engineering.ualberta.ca/en/Graduate.aspx

CIVIL AND ENVIRONMENTAL ENGINEERING

www.civil.engineering.ualberta.ca/en/Graduate.aspx

ELECTRICAL AND COMPUTER ENGINEERING

www.ece.engineering.ualberta.ca/en/Graduate.aspx

MECHANICAL ENGINEERING

www.mece.engineering.ualberta.ca/en/Graduate.aspx

REMEMBER – graduate programs are highly individualized and academic qualification alone is not sufficient for admission in thesis-based programs. You must identify a specific project and have it agreed upon by a prospective thesis supervisor. For this reason, it is essential to approach individual professors working in areas of interest to you early in your search process.

Admission to all programs is administered through the Faculty of Graduate Studies and Research. Please visit www.gradstudies.ualberta.ca for additional information about applications to graduate programs and other information about graduate studies at the University of Alberta.

Graduate students in the Faculty of Engineering have access to \$200M in state-of-the-art nanotechnology facilities on campus, including the nanoFAB, an open-access fabrication facility housed in Department of Electrical and Computer Engineering.

“These facilities give students access to all of the tools they need to follow their curiosity,” say Ryan Tucker (left). “If someone asks ‘Can we try that experiment here?’ the answer is ‘Yes! We can do that *today*.’”

International

International Applicants

The University of Alberta's Faculty of Engineering is home to more than 1200 international graduate students from more than 65 countries. International students and alumni praise the Faculty of Engineering for its highly respected and accessible faculty members and cutting-edge research facilities. They also appreciate Canada's safe, welcoming and supportive multicultural community.

International application deadlines

If you are applying from outside of Canada (or from within Canada with a study permit), you should be aware that most departments have earlier application deadlines for international applicants to accommodate timelines to secure any necessary visas.

English is the Faculty of Engineering's language of instruction. International applicants will require proof of their proficiency in English in order to be admitted. Proficiency is typically demonstrated using the Test of English as a Foreign Language (TOEFL).

International admission agreements

The University of Alberta has signed agreements to co-sponsor international student admission into several U of A graduate programs. The agreements promote collaboration in a variety of fields. Details can be found at: www.gradstudies.ualberta.ca/applyadmission/intlagreements.aspx

Financial Support for Graduate Studies

Almost all thesis-based graduate students receive financial support through external and internal scholarships, research assistantships, tuition support and teaching assistantships. Support levels vary, but are generally sufficient to cover tuition costs and basic living expenses. The Faculty of Engineering provides approximately \$19M in financial support to graduate students annually.

Additional information on funding for graduate students can be found on the University of Alberta's website: www.gradstudies.ualberta.ca/awardsfunding

Financial Support

Immediately after completing her PhD, Lucy Nolan (right) was hired as a yield engineer with Intel in Portland, Oregon. Because she sees new chip designs long before they come to market, the specifics of what she does are top-secret. Lucy now balances life in a lively city with the pursuit of a dream career.

"Working here is fantastic!" she says. "I'm working on projects that are on the absolute cutting edge. It's amazing."



Putting the polish on a bright future

After spending a semester at the University of Alberta in 2003 on exchange from the University of Wollongong in Australia, Lucy Nolan (BSc 04, PhD 12) realized she felt right at home in Edmonton. So, in 2008 she returned to the Faculty of Engineering to pursue her PhD as part of a research group led by Dr. Ken Cadien in the Department of Chemical and Materials Engineering. Dr. Cadien had recently left one of the most senior technical positions at Intel Corporation to become the Canada Research Chair in Nanofabrication.

Lucy's research focused on chemical-mechanical polishing of copper in the production of semiconductor devices. Copper has become the material of choice for the tiny 'wires' within microchips, but its use requires polishing with chemicals and nano-sized abrasives. Industry has been doing this successfully for years, but no one is entirely sure how it works, making the process difficult to improve.

"I discovered that, with literally thousands of variables, completely unpredictable outcomes, and no effective computer modeling system, the challenges in this field were enormous and incredibly exciting."

In addition to challenging herself intellectually at graduate school, Lucy found work-life balance by joining a local women's Australian Rules football team. After two years, she wound up playing for Canada in the 2011 International Cup in Australia (and winning a silver medal). It was a complete change from life in the lab.

"Graduate research is an individual pursuit," Lucy notes, "and to be part of a team was a great counterbalance. Practices and games were a real release."

Sinking his teeth into innovation

While Cristian Scurtescu (BSc 03, MSc 07) was still working on his graduate degree, he helped develop an innovative device to facilitate non-invasive treatment and prevention of dental root problems.

In 2008, he founded his own start-up company, SmileSonica Inc., with that early stage technology.

“There was no question in my mind that I’d matched a technical solution to a defined market need,” he says.

Today, SmileSonica employs more than 10 people – the majority of whom hold advanced degrees from the University of Alberta. Cristian plans to ship devices for use in dental practices within a year.

Cristian joined the Department of Electrical and Computer Engineering in 2004. He was one of three students to receive the iCORE International Student Award. During his MSc studies, Cristian participated in a collaboration between Engineering and Dentistry to design, test and fabricate microelectronic circuits and transducers for new intra-oral ultrasound devices intended to stimulate dental tissue repair.

After graduation, Cristian decided he needed to move the technology from the lab to dentists’ offices. His initial financial support and mentorship came from the MSTRI entrepreneur development program administered by the Faculty of Engineering (now called nanoBridge). With this funding and coaching, Cristian was able to build a solid business plan and work on early prototypes.





U of A

The University of Alberta

The University of Alberta is one of the top 100 universities in the world, and a leader amongst Canada's comprehensive, research-based universities. Founded in 1908, the University serves more than 38,000 students and has annual external research funding in excess of \$500M.

Faculty, staff and students in the 400 research laboratories on campus are focused on cutting-edge, multidisciplinary research and are supported by \$1.1B in new building construction and Canada's second largest library system. Technology translation at the university, an important focus for many members of the Faculty of Engineering and their collaborators, has resulted in 1,150 invention disclosures, 360 patents, and 70+ spin-off companies in the last 13 years.

For more information about the University of Alberta, please visit: www.ualberta.ca



Cristian Scurtescu's startup company, SmileSonica, is currently focused on product development, thanks to a combination of private funds and provincial and federal grants. The company is housed in incubator space in the National Institute for Nanotechnology where Cristian and his team (left) can access prototyping tools in the nanoFAB, design software in the Integrated Nanosystems Research Facility, and product development resources from the Alberta Centre for Advanced MNT Products.

Edmonton

About Edmonton

Edmonton is the capital city of Alberta and home to more than one million people. Located along the North Saskatchewan River, the city is safe, welcoming and values multiculturalism. It boasts North America's largest expanse of urban parkland, which includes more than 97 km of multi-use trails.

Often called "Canada's Festival City," Edmonton hosts over thirty cultural festivals throughout the year to celebrate the arts, music, food and sport. Major annual events include Canadian Finals Rodeo, Edmonton Street Performers Festival, K-Days, Edmonton Folk Music Festival and the Fringe Theater Festival.

The University of Alberta's main campus is located on the south side of the North Saskatchewan River. From campus, you can travel easily to other parts of the city via light rail transit and an extensive bus network. Downtown, which is approximately 10 minutes away by transit, is home to the head offices of many of Canada's largest engineering firms, including those who are close collaborators with the Faculty of Engineering. These firms help to drive Edmonton's diverse and robust economy, which ranges from knowledge-based to resource-driven industries, including oil production, petrochemicals, agriculture, forestry, mining and construction. Edmonton is also considered Canada's gateway to the robust resources sector in northern Alberta and northern Canada.

The campus is also a short walk from Old Strathcona, a historical district that is home to some of Edmonton's most unique shops, movie theatres, restaurants and coffee houses. For those wishing to venture farther afield, a few hours' drive west will bring you to Jasper and Canada's Rocky Mountains, where you can explore the outdoors by camping, hiking, skiing, or simply enjoy the stunning scenery.



Edmonton is served by the country's fifth largest airport, Edmonton International Airport (EIA). Located approximately 20 minutes from the city's southern boundary, EIA offers non-stop air service to more than 50 national, US and international destinations.

For more information about the city, please visit: www.edmonton.ca

Nadia Shafie Zadeh (right) chose the Department of Civil and Environmental Engineering at the University of Alberta for its outstanding international reputation and was pleased to accept a Provost Doctoral Entrance Award.

"At the University of Alberta, I've found a caring supervisor, excellent facilities and an interesting, industry-facing project," Nadia says. "All the tools for success in graduate school are here."



Looking beneath the surface for solutions

Nadia Shafie Zadeh (BSc 99, MSc 04) is trying to accurately characterize stresses in caprock materials for oils sands steam assisted gravity drainage (SAGD) and carbon capture and storage (CCS) projects. Caprock lies between a reservoir and the surface, and having an accurate understanding of the far-field stresses in this material improves reservoir safety and recovery. Combining data collected in-lab (for estimating geomechanical properties) with in situ micro-hydraulic fracturing data from industrial partners pursuing SAGD in Alberta's oil sands, Nadia is using numerical methods to provide new insights into caprock in situ stress interpretation.

Dr. Rick Chalaturnyk, Nadia's mentor, is the theme lead for CCS projects in the Helmholtz-Alberta Initiative (HAI). The HAI is a \$33M strategic alliance between the Helmholtz Association of German Research Centres and the University of Alberta that fosters international research collaborations in sustainable use of energy resources. As an HAI student, Nadia travelled to Germany to participate in the 2nd HAI Science Forum where she met her collaborators face-to-face. For Nadia, it was an important opportunity to observe alternate approaches to energy research.

Nadia's scientific curiosity has driven her to become an expert in her field. After completing both her BSc and MSc, and several years of work with Lar Consulting Engineers in Iran, Nadia chose to pursue further education in Canada.

"I was drawn to the combination of high technology research and a safe, friendly environment," she explains.

Graduating to a career

Christopher Lin (BSc 06, PhD 09) earned his PhD in a fast-paced research group, working directly with companies like NOVA Chemicals, General Electric and Imperial Oil. Mentored by Dr. Steven Kuznicki (Canada Research Chair and NSERC/NOVA Chemicals Senior Industrial Research Chair in Molecular Sieves) of the Department of Chemical and Materials Engineering, Christopher learned to critically analyze research questions and pursue inventive solutions. Along the way, he authored five patent applications and 18 peer-reviewed publications, all addressing the synthesis and applications of zeolite molecular sieves.

Christopher was hired as a Tailings Management Specialist at Imperial Oil immediately after graduation. His first assignment was to develop technologies to reduce oil sands tailings toxicity and accelerate reclamation. For Christopher, it represented a significant challenge in a new field.

“I immediately realized that I didn’t know the answer or even where to start,” he explains. “Fortunately, I had learned how to tackle a new discipline and new research questions in graduate school.”

With that experience and knowledge behind him, Christopher has been able to make significant and rapid progress in his work. In fact, the technology developed by his team has become a lead option for tailings management.

Christopher’s current focus is on the use and re-use of water in oil sands operations. He represents Imperial Oil’s water research programs in Canada’s Oil Sands Innovation Alliance, an industry-wide consortium. Christopher also acts as steward for projects within the Centre for Oil Sands Innovation (COSI) at the University of Alberta. The \$50M research centre is developing technologies for cleaner, lower-cost oil sands operations that reduce water and energy consumption, and greenhouse gas emissions. Through COSI, Christopher has the opportunity to work with Engineering faculty members who share his goal of “making Alberta’s energy a sustainable resource for the world.”



Mineral Processing Mining Engineering Molecular Sieves Nanoelectronics Nanofabrication Nanotechnology Non-Aqueous Bitumen Extraction Oil Sands Tailings Oil Sands Upgrading Petroleum Engineering Petroleum Thermodynamics Photonics and Electromagnetics Pipelines and Pipeline Transport Plasmas Polymer Engineering Power Electronics and Systems Process Control Rail Hazards and Safety Renewable Energy Robotics Safety and Risk Management Signal and Image Processing Smart Grids Software Engineering Solid Mechanics Structural Engineering Synthetic Biology Systems and Control Systems Biology Tailings Management Thermal Conversion Thermodynamic Thermo-fluids Transportation Engineering Unconventional Oil Recovery Water Quality Management Water Resources Welding and Joining Wireless Systems Advanced Fuel Cells Aerosols and Particle Dynamics Biochemical Engineering Biomechanics Biomedical Engineering Carbon Capture and Storage Catalysis and Reaction Engineering Colloid Communications Computational Intelligence Computer Engineering Construction Engineering and Management Corrosion and Wear Drug and Gene Delivery Electronic Materials and Devices Energy and the Environment Energy Systems Engineering Management Environmental Engineering Environmental Remediation Fluid Dynamic Geostatistics Geotechnical Engineering Information and Communications Technologies Integrated Circuits Interfacial Engineering Magnetic Resonance Imaging (MRI) Materials Processing Mathematical Modeling Metamaterials Micro and Nano-Electromechanical Systems Micro- and Nanofluidics Mineral Processing Mining Engineering Molecular Sieves Nanoelectronics Nanofabrication Nanotechnology Non-Aqueous Bitumen Extraction Oil Sands Tailings Oil Sands Upgrading Petroleum Engineering Petroleum Thermodynamics Photonics and Electromagnetics Pipeline and Pipeline Transport Plasmas Polymer Engineering Power Electronics and Systems Process Control Rail Hazard and Safety Renewable Energy Robotics Safety and Risk Management Signal and Image Processing Smart Grid Software Engineering Solid Mechanics Structural Engineering Synthetic Biology Systems and Control System Biology Tailings Management Thermal Conversion Thermodynamics Thermo-fluids Transportation Engineering Unconventional Oil Recovery Water Quality Management Water Resources Welding and Joining Wireless System Advanced Fuel Cells Aerosols and Particle Dynamics Biochemical Engineering Biomechanics Biomedical Engineering Carbon Capture and Storage Catalysis and Reaction Engineering Colloid Communications Computational Intelligence Computer Engineering Construction Engineering and Management Corrosion and Wear Drug and Gene Delivery Electronic Materials and Devices Energy and the Environment Energy Systems Engineering Management Environmental Engineering Environmental Remediation Fluid Dynamic Geostatistics Geotechnical Engineering Information and Communications Technologies Integrated Circuits Interfacial Engineering Magnetic Resonance Imaging (MRI) Materials Processing Mathematical Modeling Metamaterials Micro and Nano-Electromechanical Systems Micro- and Nanofluidics Mineral Processing Mining Engineering Molecular Sieves Nanoelectronics Nanofabrication Nanotechnology Non-Aqueous Bitumen Extraction Oil Sands Tailings Oil Sands Upgrading Petroleum Engineering Petroleum Thermodynamics Photonics and Electromagnetics Pipeline and Pipeline Transport Plasmas Polymer Engineering Power Electronics and Systems Process Control Rail Hazard and Safety Renewable Energy Robotics Safety and Risk Management Signal and Image Processing Smart Grid Software Engineering Solid Mechanics Structural Engineering Synthetic Biology Systems and Control System Biology Tailings Management Thermal Conversion Thermodynamics Thermo-fluids Transportation Engineering Unconventional Oil Recovery Water Quality Management Water Resources Welding and Joining Wireless System



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