ANNUAL REPORT FOR 2018

Submitted by

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Professor and Chair

Department of Mining and Materials Engineering

McGill University

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Description of Unit

The Department of Mining and Materials Engineering is home to two separate programs in mining engineering and materials engineering offering exciting opportunities for first degree (B.Eng.) or post-graduate education (M.Sc./M.Eng., Ph.D.) and research training (PDF). The mining program is housed in the FDA building and the materials program in the Wong building. Our department in 2018 had 21 full-time professors (6 in Mining and 15 in Materials), 1 senior faculty lecturer (Materials), 2 active Emeritus Professors, 1 Post-Retirement Professor and 12 non-academic staff (Administrative Officer, 2 Co-op coordinators, 2 U/G coordinators, 1 Graduate coordinator, 1 Financial Service Team Manager, 1 payroll clerk, 4 technical staff). Of the full-time faculty, 7 are Full Professors, 12 are Associate Professors, and 2 are Assistant Professors. During the year we welcomed two new faculty members, Prof. Sidney Omelon in Materials and Prof. Alessandro Navarra in Mining. (Full list of all our faculty staff is given in a Table at the end of the report).

In 2018, there were 369 undergraduates in total (107 in mining and 262 in materials) and 188 graduate students (53 in mining and 135 in materials) enrolled in Mining and Materials Engineering degree programs-full data is provided in a later Table. It is noteworthy that both Mining and Materials undergraduate programs require minimum 12 months of work experience for students to graduate. These are the only two co-op programs offered at McGill at this time. Recent trends that have seen enrolment to substantially increase and more tight conditions in finding placement for our students in industry has prompted us to create non-co-op options for our two programs. There is no direct admission to these non-co-op options, but students can transfer into them once they have met certain requirements and obtained approval from the departmental adviser.

Our research efforts were supported by 33 postdoctoral fellows and 19 research assistants/associates. These strong HQP numbers reflect our continuing leadership in research intensity that puts our department in number 1 position for example in terms of research funding among all engineering departments ($273k/professor in 2016; data released in January 2018 by McGill's Office of Analysis Planning and Budget and the VPRI Office as part of the report: Sponsored Research Profile-Faculty of Engineering 2012-2016). The renovation of the high-temperature laboratories (“Foundry”) progressed throughout 2018 albeit with delays and some design problems.

2018 Milestones

- We welcomed a new Associate Professor in Materials, Prof. Sidney Omelon in January 2018
- We welcomed a new Assistant Professor in Mining, Prof. Alessandro Navarra in August 2018
- Undergraduate Coordinator Teresa Zatylny received the Dean of Students Award for Excellence in Undergraduate Academic Advising and also retired in 2018 after 9 years in the Department
- We received the sad news of Helen Campbell’s passing in 2018. Helen worked for over 30 years as our electron microscopy and metallography laboratory expert.

Research and Publications: 2018 Highlights

Department-wide research funding in 2018 was $6.2 million ($1.2 million in mining and $5 million in materials). This translates to approx. $295k/researcher. Notable is the high level of industrial research funding received at the level of $1.3 million. Our researchers attract a lot of NSERC CRD grants (an area in which other departments are not as active; these grants require substantial cash from industrial partners >35% of total grant) as well as NSERC Strategic Project grants (SPG). Indicatively in 2018 there were 15 active CRD and 8 SPG grants led (as PIs) by members of our department. Steve Yue continues to lead the NSERC CREATE in aerospace research ($1.65 million over 6 years), Roussos Dimitrakopoulos the CRC I in sustainable mineral resource development ($1.4 million over 7 years) and Marta Cerruti the CRC II in bio-synthetic interfaces ($500,000 over 5 years).

The following is a count, by category, of approx. 151 current grants
Operating Grants Held as Principal Investigator: 107 (including 29 new)
Professors as co-investigator: 34 (10 new)
Infrastructure Grants held: 10 (1 new)
Submitted grants during 2018: 62

New for 2018 – Major/Notable Research Grants:
- Brochu, Mathieu; CRIAQ-NSERC, Additive Manufacturing of Aerospace Components - II, M. Brochu, J. Song, Y. Zhao, Myriam Brochu (Poly), R. Gauvin, P. Wanjara and A. Bois-Brochu, total grant $879,000
- Demopoulos, George with Gauvin, Raynald and Perepichka, D.; NSERC Strategic; Development of 3D hybrid electrolytes and nanostructured electrodes for scalable manufacturing of new-generation solid-state lithium batteries, total grant $580,500
- Song, Jun (PI) with Yue, S. (Co-PI), Gauvin, R. (Co-PI), Mousseau, P. (Co-PI); NSERC Strategic; Predictive assessment of hydrogen diffusion and segregation in high-strength steels: an ICME approach, total grant $489,880

For 2018, 182 peer-reviewed refereed journal papers (list is here: http://www.mcgill.ca/minmat/) were published by Departmental faculty (37 in Mining and 145 in Materials) for an impressive 8 J papers/professor average output. In addition, our faculty and students were very active at presenting and publishing their work in conferences. Refer to the individual faculty member (people) pages (within the sections for the two programs Materials and Mining) for details here: http://www.mcgill.ca/minmat/.

Notable mention should be made to IP protection activity in our department. Our members filed: 4 Reports of Invention; 2 U.S. provisional patent applications and 1 international patent application. To these we should add the issuing of Chinese and Japanese patents to Professor Demopoulos covering layered and spinel lithium titanate processes for preparing the same.

Finally, the faculty staff were very active presenting invited talks in conferences and institutions (refer to people pages at: http://www.mcgill.ca/minmat/). Notable among them are:
- Cerruti M., Invited keynote talk at the inaugural meeting of the Canadian Chapter of the American Ceramic Society, Montreal, “What do diabetes and malaria have in common? A scientific and personal journal from bioceramics to our world's grand challenges”.
- Chromik, Keynote Lecture: The importance of tribofilm formation for metal-matrix composites, Symposium on Recent Developments in Tribology, Materials Science and Engineering Conference (26-28 Sept 2018 in Darmstadt, Germany).
- Dimitrakopoulos, R., Keynote Lecture: "Simultaneous Optimization of Mining Complexes and Mineral Value Chains under Uncertain Metal Supply and Market Demand: New smart digital technologies for lower risk, higher metal production, better cash-flows”. University of Science and Technology Beijing, Beijing, China, July 4, 2018
- Dimitrakopoulos, R. Keynote Lecture: "The high-order stochastic sequential simulation framework: A review with examples." IAMG2018, 19th annual conference, International Association for Mathematical Geosciences, Olomouc, Czech Republic, September 5, 2018
- Kumral, M., Principal speaker on mine optimization in V International Mine Planning Symposium (Siplamin), Universidad Nacional de Ingeniería, 22-24 November, 2018, Lima, Peru.
- Mitri, H., Keynote speaker, Destress Blasting – From Theory to Practice. 4th World Congress on Mechanical, Chemical, and Material Engineering (MCM'18) Madrid, Spain – August, 2018.
- Nazhat, S., Invited Talk: March 2018 Department of Chemical, Materials, and Industrial Production Engineering, University of Naples Fredrico II, Italy.
- Omelon, S., “Elemental Shell Games: Small-to-Large Scale Structures and Chemistry of Phosphate Biominerals” Klausur Meeting for the Department of Biomaterials, Max Planck Institute of Colloids and Interfaces. May 22nd - May 25th, Retgendorf, Germany.
- Sasmito, A., Invited Speaker: Advanced Multiphysics system for sustainable mining, Shandong University of Science and Technology, Qingdao, China, Oct 2018.

Teaching and Learning

Undergraduate programs & students: Both academic programs have seen considerable growth over the past years as the summary table below highlights. This success creates challenges in maintaining our ability to provide full and meaningful co-op jobs. Among the measures taken to address this challenge were placement of several of our co-op students in research trainee positions supervised by our professors or in other department academic labs; and in parallel we introduced non-co-op options. In 2018, a total of 144 materials engineering co-op students were placed (W18=34/ S18 =62/ F18=48). There was a 5% decrease since 2017 in the number of students placed in McGill labs for the Materials co-op jobs. At the same time, there were 75 co-op job placements in mining engineering (58 new and 17 continuing from 2017). 21 of the job placements were “research” type jobs through MUST, SURE or at other (international) universities.

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In terms of job placement at graduation statistics (based on annual surveying of graduating students done by MESC) we saw 76% and 75% of our graduates in materials (36) and mining (28) respectively to either have found jobs already or continuing to post-graduate studies. The latter is an option that seems to be increasingly pursued by our materials graduates.

The Materials co-op team continued its annual Materials Engineering Student-Industry Awards & Networking event to recognize academic achievement and to highlight the employer’s investment in
the co-op program. The second annual MOTH (MEUS on the Hunt) Peer Advising Program was also held to help first time co-op job seekers get job-ready.

Both the Mining and Materials undergraduate student societies were very active organizing academic fora, invited seminars, participating in conferences (e.g. TMS, the Canadian Materials Science Conference, in the case of our materials students or CIM Annual General Meeting by our mining students) and various field trips including one organized by the Metsoc student chapter for a student industry tour to Bombardier’s Materials & Processing Lab in Montreal that regularly hires the materials co-op students from McGill. The industry panel discussions Mat Talk (Materials) and Min Talk (Mining) were also held again 2018.

Undergraduate scholarships and awards: Entrance scholarships in the amount of $49,165 were awarded to new Undergraduate students in 2018. As in previous years, the Faculty and Department also awarded its undergraduate students in-course for high academic achievement. The McGill awards given amounted to $37,180 for a total of $86,345 in Undergraduate scholarships for 2018. In the meantime several of our students received external awards, notable among these are: Bashir Ahmed, Xavier Chagnon, Antoine Cossio-Buquich, Rim Koulder, Kristi Kulla, Simon Lacoste-Bouchet, Charles (Gordy) Noel, Matthew Renaud and Adam Stanley were awarded CMIEF Scholarships; Ding Zhong received the Birks Silver Medal and the McGill Mining team consisting of Christopher Cardazzi, Mélanie Laroche-Boisvert, Charles (Gordy) Noel and David Kimmett was the winner of the 2018 Kinross Underground Mine Design Contest. Congratulations to all!

Graduate students and scholarships: Graduate student enrollment remained strong (see Table above). The breakdown in terms of graduate degree statistics in 2018 was: Mining: 24 PhD; 3 M.Sc.; 26 M.Eng. and Materials: 100 PhD; 8 M.Sc.; 27 M.Eng. This translates to 5.9 PhD students per professor on average! The corresponding graduation statistics are: Mining: 8 M.Eng. and 4 Ph.D., and for Materials: 19 PhD and 15 M.Eng. The MEDA awards have provided much needed impetus in attracting Ph.D. students, 25 new students in 2018. At $24,000 to $32,000 in value for each scholarship of which 50% is covered by the Faculty of Eng. this amounts to ~ $325,000 in extra research support for our graduate students. The department’s Graduate Studies Committee recognizes graduate students for their research excellence. Medals or certificates and monetary prizes (approximately $47,000) were awarded based on a student’s overall research publication production while at McGill. Departmental excellence awards were given to graduate students Christopher Marion (Gold), Samantha Rudinsky (Silver) and Mahmoud Alzoubi & Jeffrey Templeton (Bronze). Details can be found at the following link: [http://www.mcgill.ca/materials/graduate/graduate-awards](http://www.mcgill.ca/materials/graduate/graduate-awards)

New or major continuing teaching initiatives:

- Prof. Kirk Bevan completely re-developed MIME 209 with 20 entirely new lectures and 6 entirely new homework sets which include some MATLAB content
- Prof. Kirk Bevan developed an Arduino based feedback control tutorial for MIME 311 using a photoresistor and a light emitting diode in order to provide more applied control examples for students to undertake during the course.
- Prof. Marta Cerruti appointed by the Faculty of Engineering as the 2018-2019 “Farnell Teaching Scholar” to introduce new teaching strategies in our department.
- Dr. Florence Paray helped design and re-design many laboratory programs for the department including the improvement of active teaching in scanning electron microscopy for MIME317 and MIME569

Involvement in the Community

Highlights of community involvement include:
• Bevan, Kirk: Lead organizer of the Computational Materials North Workshop (August 2nd & 3rd, 2018)
• Brochu, Mathieu: Chair of 16th International Conference on Aluminum Alloys (2018) & Co-Chair Additive Manufacturing and Powder Metallurgy Conference, MPIF, June 24th-28th
• Cerruti, Marta: Vice President of the Canadian Chapter of the Controlled Release Society for their conference held in Toronto in May 2018
• Chromik, Richard: Elected Member of the Advanced Surface Engineering Division of the American Vacuum Society
• Gauvin, Raynald: Chair of the Symposium, The Joy of the SEM at the Microscopy and Microanalysis 2018 Conference & Chair of the Symposium, Scanning Electron Microscopy at the 9th International Microscopy Conference, IMC 19
• Mitri, Hani: International Chair for the 4th International Symposium on Mine Safety Science and Engineering held in Beijing from October 20 to 22, 2018
• Sasmito, Agus: Scientific Committee and Session Chair in International Conference on Sustainable Energy and Green Technology 2018
• Song, Jun: CIM MetSoc Society’s Materials Section Chair and Materials Science and Technology (MS&T) 2018 Organizing Committee Chair of the Symposium on Environmental Embittlement
• Materials PhD student Christina Maria Katsari organized in November 2018 the “Materials under the Microscope” activity as part of the week promoting STEM to high school students (The McGill Reporter, Jan 24, 2019)

Major Honours, Awards, and Prizes
• Cerruti M. – Honoured at the 2018 BRAVO Gala as one of 47 McGill Professors celebrated for their extraordinary achievements in 2017
• Demopoulos G. - Inducted as Fellow to the Canadian Academy of Engineering
• Dimitrakopoulos R. – Awarded the Mann Redmayne Medal from the Institute of Materials, Minerals and Mining jointly with the Australian Institute of Mining and Metallurgy & honoured at the 2018 BRAVO Gala as one of 47 McGill Professors celebrated for their extraordinary achievements in 2017
• Gauvin R. - Awarded an Industrial Research Chair with Hydro-Quebec and the Natural Sciences and Engineering Research Council of Canada
• Guthrie R. - Named an Honorary Fellow of the TMS (The Metals, Minerals and Materials Society)
• Hassani F & Sasmito A – Won The Best Paper Award in International Conference on Sustainable Energy and Green Technology 2018 in Kuala Lumpur Malaysia
• Nazhat S. - Received the William and Rhea Seath Award in Engineering Innovation
• Song J. - Received the MetSoc BRIMACOMBE Award by The Metallurgy and Materials Society of CIM & Was awarded the William Dawson Scholar Award
• PhD Student William Lepry (supervised by Professor Nazhat) received the Governor General’s Gold Medal for his thesis- first time one of our graduate students receiving this distinction!

Respectfully submitted by

George P. Demopoulos
August 2019
APPENDIX: Professors and Rank/Title/Position in Mining and Materials Engineering for 2018

Full Professor
Demopoulos, George, Gerald Hatch Chair, Materials Engineering, and Department Chair
Dimitrakopoulos, Roussos, Canada Research Chair I, Mining Engineering
Gauvin, Raynald, Birks Chair & Industrial Research Chair, Director, Materials Characterization Facilities, Materials Engineering
Guthrie, Roderick, Macdonald Professor, Director of MMPC, Materials Engineering
Hassani, Faramarz, Webster Chair, Mining Engineering
Mitri, Hani, Director of Mining Engineering
Yue, Stephen, James McGill Professor, Trottier Chair and Director of MIAE, Materials Engineering

Associate Professor
Bevan, Kirk, Materials Engineering
Brochu, Mathieu, G. Hatch Faculty Fellow, Materials Engineering, Associate Chair-Graduate Studies
Cerruti, Marta, Canada Research Chair II, Materials Engineering, Associate Chair-Academic-Materials
Chromik, Richard, G. Hatch Faculty Fellow, Materials Engineering, Associate Dean-Faculty Affairs
Hasan, Mainul, Materials Engineering
Kumral, Mustafa, Mining Engineering
Nazhat, Showan, Materials Engineering
Omelon, Sidney, (New hire in January 2018), Materials Engineering
Pekguleryuz, Mihriban, Materials Engineering
Quitoriano, Nathaniel, Director of Materials CO-OP Program, Materials Engineering
Song, Jun, Materials Engineering
Waters, Kristian, Materials Engineering

Assistant Professor
Navarra, Alessandro, (New hire in August 2018), Mining Engineering
Sasmito, Agus, Mining Engineering

Senior Faculty Lecturer
Paray, Florence, Associate Director, Characterization Facilities

Emeritus Professor (Active)
Finch, James
Jonas, John

Post Retirement Professor (Active)
Mucciardi, Frank