



ANNUAL REPORT FOR 2017

Submitted by

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Professor and Chair**

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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 2017 had 21 full-time professors (5 in Mining and 16 in Materials), 1 faculty lecturer (Materials), 2 active Emeritus Professors, 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, 13 are Associate Professors, and 1 is an Assistant Professor. During the year one of our Associate Professors (Mucciardi) retired and appointed Post-Retirement Professor while another (Jung) resigned to take a position abroad. (Full list of all our faculty staff is given in a Table at the end of the report). In 2017, there were 373 undergraduates in total (108 in mining and 265 in materials) and 160 graduate students (43 in mining and 117 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 initiate the creation of non-co-op options for our two programs final approval of which is pending.

Our research efforts were supported by 36 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 and schools according to PIA office (\$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). We have world-class laboratory and computer facilities in both disciplines but we face space constraints in particular in the Wong building where Materials Engineering is housed, a situation that hopefully will improve in the future with the Royal Victoria Hospital site expansion plans. The renovation of the high-temperature laboratories ("Foundry") moved into the final planning stage with construction started in early 2018.

2017 Milestones

- Prof. Rod Guthrie reached the 50 years of service milestone at McGill-he was appointed Assistant Professor back in 1967 and continuing strong!
- Prof. Frank Mucciardi retired in 2017 after 48 years at McGill, first as an undergraduate, then as a Master's student, as a Doctoral Student, and finally as a Professor.
- Prof. In-Ho Jung left the Department in August (after 10 productive years) to take a position with the Seoul University in South Korea.
- Technician Monique Riendeau retired in 2017 after 38 years of service at McGill
- Professors Bevan, Kumral and Song were granted tenure.
- Professor Marta Cerruti was named 2017 Young Scientist by the World Economic Forum. The Forum honours 55 Young Scientists under the age of 40 in recognition of their contribution to cutting-edge research; also she obtained her professional engineering license.

Research and Publications: 2017 Highlights

Department-wide research funding in 2017 was \$6 million (\$1.2 million in mining and \$4.8 million in materials). This translates to approx. \$285k/researcher. Notable is the high level of industrial research funding received at the level of \$1 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 2017 there were 24

active CRD and 9 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), Marta Cerruti's CRC II in bio-synthetic interfaces was renewed for another 5 years (\$500,000).

The following is a count, by category, of approx. 160 current grants

Operating Grants Held as Principal Investigator:	104 (including 30 new)
Professors as co-investigator:	37 (8 new)
Infrastructure Grants held:	19 (5 new)
Submitted grants during 2017:	51

- New for 2017 – Major/Notable Research Grants: Brochu, Mathieu (co-PI); CFI 2017, 9th round, Canadian Additive Manufacturing Network. E. Toyserkani (PI) and A. Khajepour (Waterloo), M. Brochu, D. Pasini and Y. Zhao (McGill), P. Bishop and S. Corbin (Dalhousie), S. Cockcroft and Y. Altintas (UBC), total grant of \$18,843,073
- Brochu, Mathieu (PI); CRIAQ-CARIC MANU 1613, Manufacturing of A205 components, J. Larose (PWC) + 9 industrials + 6 academics, total grant of \$1,930,869
- Cerruti, Marta (PI); NSERC Strategic with Szkopek and Barthelat “Engineering graphene oxide membranes to achieve high fidelity speakers with low dimensional materials”, total grant of \$469,400
- Dimitrakopoulos, Roussos; NSERC CRD, "Smart mining complexes: Large-scale stochastic optimization, high-order simulation and self-learning decision support systems for sustainable development of mineral resources", total grant of \$2,755,627
- Gauvin, Raynald (co-PI); CFI Innovation Fund, Quebec Network for Electron Microscopy of Materials, N. Braidi (PI), and 8 others, total grant of \$23,291,814
- Song, Jun; Received the NSERC Discovery Accelerator Supplement (DAS), Bottom-up computational design of hybrid 2D/3D nanostructures, \$120,000.

For 2017, 190 peer-reviewed refereed journal papers (list is here: <http://www.mcgill.ca/minmat/>) were published by Departmental faculty (49 in Mining and 141 in Materials) for an impressive 9 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: 1 Report of Invention and 4 U.S. provisional patent applications. To these we should add the issuing of 2 US patents to Professor Demopoulos covering innovations in lithium titanate and HCl regeneration technologies; 1 US patent to Professor Nazhat covering dense hydrogels.

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:

- Bevan, K., Invited Talk at the University of Saarland, Department of Materials Science, "Exploring Bridges Between Physics and Electrochemistry", Saarbrücken Germany (October 2017).
- Brochu, M., Linking microstructure, impact properties and deformation mechanisms of laser powder bed fusion Ti-6Al-4V parts in Materials Science & Technology, October 2017.
- Cerruti M., From upconverting nanoparticles to graphene: when surfaces matter. JACS symposium on Advanced Materials Technologies, ACS Spring meeting San Francisco, USA, April 2017.
- Chromik, Cold sprayed coatings for tribological applications, at National Research Council, Boucherville, QC, Canada (February 2017).
- Demopoulos, G., “Precipitation and Crystallization: Theoretical Fundamentals and Applications”, in Short Course on Hydrometallurgy, European Institute of Innovation & Technology, Raw Materials Program, Universite de Liege, Belgium (December 2017).

- Dimitrakopoulos, R., Optimization with Risk Management in Strategic Mining Planning: from Single Mines to Mining Complexes and Mineral Value Chains under Uncertain Metal Supply, SME 2017 Annual Conference & Expo, Denver, Feb 2017.
- Gauvin, R, “Electron Microscopy in the FE-SEM, What’s next?”, NN17 Nanotechnology Conference, Thessaloniki, Greece, July 2017; and “X-Ray Microanalysis and High Resolution Imaging in the FE-SEM”, Invited university seminars in Florida and Shanghai.
- Kumral, M., Two invited presentations on Mine Safety at North China Institute of Science and Technology and Shandong University of Science and Technology in December 2017.
- Mitri, H., Destress Blasting – From Theory to Practice at China University of Mining and Technology, Henan Polytechnic University, and Shandong University in China (March 2017).
- Nazhat, S., February 2017: Keynote Speaker at Canadian Biomaterials Society-Montreal Student Chapter, CHUM, Montreal, Canada.
- Sasmito, A., Multiphysics modelling in mine energy systems, at Tokyo Institute of Technology, Tokyo, Japan, October 2017.
- Song, J., First-principles Computational Design of Complex Ceramic Oxides, International Workshop on High Temperature Materials 2017, Changwon, South Korea, December 2017
- Waters, K., Invited Keynote Presentation at UK Colloids 2017, Birmingham (U.K.): The value of bubbles - floating metals and minerals.
- Yue, S., “Thermomechanical Processing of Rene 65” at the 6th Int’l Symp. on Jet Propulsion and Power Engineering;; and Guest Lecturer at Beihang Summer School in China.

Teaching and Learning

Undergraduate programs & students: Both academic programs have seen considerable growth over the past years as the summary table below highlights. In 2017, we saw a record enrolment in our Materials Engineering program with our incoming class jumping 50% from ~50 to 78. 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; worked with the Central Admissions Office to cap materials enrolment to 65 and mining to 25; and in parallel applied for the creation of non-co-op options. In 2017, a total of 126 materials engineering co-op students were placed (93 new job placements and 33 continuing from 2016). There was about a 10% increase in students working off-campus in 2017. At the same time, there were 106 co-op job placements in mining engineering (73 new and 33 continuing from 2016). 13 of the 73 New Placements were “research” type jobs through MUST, SURE or at other (international) universities.

<u>Enrollment</u>	2017	2016	2015	2014	2013	2012	2011	2010
U/G Materials	265	241	223	215	198	168	147	110
U/G Mining	108	127	145	154	140	119	107	105
Graduate Materials	117	148	142	134	123	115	117	90
Graduate Mining	43	52	44	47	34	39	33	33
<u>Graduation</u>								
U/G Materials	43	34	39	31	36	14	14	24
U/G Mining	22	30	18	28	17	11	8	11
Graduate Materials	27	26	25	27	25	21	28	28
Graduate Mining	5	9	6	15	8	3	3	4

In terms of job placement at graduation statistics (based on annual surveying of graduating students done by MESC) we saw 76% and 68% of our graduates in materials (43) and mining (22) 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.

This past year the Materials co-op team organized its first 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 first annual MOTH (MEUS on the Hunt) Peer Advising Program was also launched in fall 2017 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. An industry panel discussion called Mat Talk was also organized for the Materials co-op students. The Mining co-op students have the equivalent Min Talk event.

Undergraduate scholarships and awards: Entrance scholarships in the amount of \$31,500 were awarded to new Undergraduate students in 2017. 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 \$47,600 for a total of \$79,100 in Undergraduate scholarships for 2017. In the meantime several of our students received external awards, notable among these are: Elizabeth Kendrick, Sabrina Lao & Hillary Williams were awarded CMIEF Scholarships; Vivian Shi received the Birks Silver Medal; Bailee Johnson the CMP Best Technical Report prize; and McGill Mining team with Alec Thomlison, Xavier Chagnon, Nicholas Jonas & Adam Stanley got the first place in the 2017 World Mining Competition (Saskatoon). Congratulations to all!

Graduate students and scholarships: Graduate student enrollment remained strong (see Table above). The breakdown in terms of graduate degree statistics in 2017 was: Mining: 23 PhD; 2 M.Sc.; 18 M.Eng. and Materials: 95 PhD; 1 M.Sc.; 21 M.Eng. This translates to 5.6 PhD students per professor on average! The corresponding graduation statistics are: Mining: 4 M.Eng. and 1 Ph.D., and for Materials: 19 PhD and 8 M.Eng. The MEDA awards have provided much needed impetus in attracting Ph.D. students, 26 new students in 2017. 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. Ph.D. students Christopher Marion and Samantha Rudinsky were awarded NSERC scholarships. 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. The names of the graduate students receiving departmental excellence awards can be found at the following link: <http://www.mcgill.ca/materials/graduate/graduate-awards>

Outstanding achievement: Graduating PhD Student William Lepry (supervised by Professor Nazhat) was awarded the Innovation Post-doctoral Fellowship created by the Faculty of Engineering for the borate glass technology!

New or major continuing teaching initiatives:

- Graduate Studies Committee led by Associate Chair Brochu successfully stewarded as per recent strategic plan the split of the Master's and PhD programs according to discipline, i.e. Materials Engineering or Mining Engineering-a change to be implemented in Fall 2018.
- Dr. Florence Paray redesigned the laboratory program for MIME 345
- Prof. Nate Quitoriano redeveloped MIME 570 to make it accessible to undergraduate students

Involvement in the Community

Highlights of community involvement include:

- Bevan, Kirk: Co-organizer of the Materials Research Society Fall 2017 Symposium on "Electronic and Ionic Dynamics at Solid-Liquid Interfaces", Boston MA (November 26th–December 1st 2017)

- Brochu, Mathieu: Co-Chair “Joining of Advanced and Specialty Materials XVIII”, Materials Science & Technology 2017, American Society of Materials, October 8th-12th, 2017, Pittsburgh
- Cerruti, Marta: Vice President of the Canadian Chapter of the Controlled Release Society
- Chromik, Richard: Chair for Symposium E: Tribology and Mechanical Properties of Coatings and Thin Films, International Conference on Metallurgical Coatings and Thin Films,
- Dimitrakopoulos, Roussos: Editor-in-Chief, Mathematical Geosciences and Board of Directors Member of GERAD (Group for Research in Decision Analysis)
- Gauvin, Raynald: Chair of the Symposium, STEM in the SEM that was held at the Microscopy and Microanalysis 2017 Conference, Saint-Louis, MI
- Hassani, Ferri: Active Canadian representative in the world Mining Congress Organization.
- Mitri, Hani: Co-founder: International Committee on Mine Safety Science and Engineering and Co-Founder of the CIM Canadian Schools Mining Committee
- Paray, Florence: Board Member of REGAL - BDR (Bureau de Direction de REGAL). REGAL is a multi-university research centre on aluminum
- Pegguleryuz, Mihriban: US Department of Energy (DOE), 2017 Annual Merit Review (AMR) Meeting of DOE's Hydrogen and Fuel Cells Program and Vehicle Technologies Office, reviewer
- Quitariano, Nate: goLEAD, Founder and Director; in addition Nate continued publishing the departmental alumni newsletter that he launched 3 years ago.
- Sasmito, Agus: Executive committee member of Publication and Scholarships, CIM Maintenance Engineering and Reliability Society
- Song, Jun: Materials Section Committee Chair; CIM Metallurgy & Materials Society
- Waters, Kristian: Editor in Chief of the International Journal of Mineral Processing.

Major Honours, Awards, and Prizes

- Emeritus Professor John J. Jonas was awarded the 2017 Acta Materialia Gold Medal
- Brochu M. – 2017 Editor’s Choice Article, Journal of Thermal Spray Technology
- Cerruti M.- named one of the 55 Young Scientists by the World Economic Forum
- Cerruti M.- one of the three finalists for the Quebec Prix de Releve Scientifique
- Cerruti M.- received the William and Rhea Seath award in Engineering Innovation
- Demopoulos G.P. - received the MetSoc Research Excellence Award
- Dimitrakopoulos R. William Christian Krumbein Medal (Int’l Assoc. Mathematical Geosciences)
- Gauvin R. - Honorary Member of the European Microbeam Analysis Society (EMAS)
- Hassani F. - Distinguished Service Medal, Canadian Mining and Metallurgy Institute (CIM)
- Nazhat S. - received the William and Rhea Seath award in Engineering Innovation
- Nazhat S. - along with Dr. William Lepry won the Inaugural L’Oréal-Dobson Startup Award in recognition of promising innovations in the areas of green chemistry, material and health sciences
- Quitariano N. – IOP Outstanding reviewer (Nanotechnology) 2016 – awarded in 2017
- Sasmito A. – Among the Top 10 Best Reviewer Award in Drying Technology

Respectfully submitted by

George P. Demopoulos

Date: August 28, 2018

APPENDIX: Professors and Rank/Title/Position in Mining and Materials Engineering for 2017

Full Professor

Demopoulos, George, Gerald Hatch Chair, Materials Engineering, and Department Chair
Dimitrakopoulos, Roussos, Canada Research Chair I, Mining Engineering
Gauvin, Raynald, Birks 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, (Tenure and promotion granted, June 2017), Materials Engineering
Brochu, Mathieu, G. Hatch Faculty Fellow, Materials Engineering, Associate Chair-Graduate Studies
Cerruti, Marta, Canada Research Chair II, Materials Engineering
Chromik, Richard, G. Hatch Faculty Fellow, Materials Engineering, Associate Chair-Academic-Materials
Hasan, Mainul, Materials Engineering
Jung, In-Ho, William Dawson Scholar (resigned and left August 2017), Materials Engineering
Kumral, Mustafa, (Tenure granted June 2017), Mining Engineering
Mucciardi, Frank, Materials Engineering (retired in May 2017)
Nazhat, Showan, Materials Engineering
Pekguleryuz, Mihriban, Materials Engineering
Quitoriano, Nathaniel, Director of Materials CO-OP Program, Materials Engineering
Song, Jun, (Tenure and promotion granted, June 2017), Materials Engineering
Waters, Kristian, Materials Engineering

Assistant Professor

Sasmito, Agus, Mining Engineering

Faculty Lecturer

Paray, Florence, Associate Director, Characterization Facilities

Emeritus Professor (Active)

Finch, James
Jonas, John