ANNUAL REPORT FOR 2016

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. The mining program is housed in the FDA building and the materials program in the Wong building. Our department in 2016 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, 11 are Associate Professors, and 3 are Assistant Professors. In 2016, there were 368 undergraduates in total (127 in mining and 241 in materials) and 200 graduate students (52 in mining and 148 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 12-16 months of work experience for students to graduate. These are the only two co-op programs offered at McGill.

Our research efforts were supported by 44 postdoctoral fellows and 21 research associates and assistants. We have world-class laboratory and computer facilities in both disciplines but we face space constraints in the Wong building where the materials activities are organized. As a consequence, a “hoteling” system for all the Materials Masters students is in place—the only one in the Faculty of Engineering, as a strategy in creating research space for CFI proposals but this is not sustainable over the longer term. In the meantime, the renovation of the high-temperature laboratories (“Foundry”) of total budget $5.8 million has been further delayed with the construction start date pushed to early 2017 with the inevitable collateral complications in HQP training and research progress. A positive development associated with this project is that it was selected to receive support by the new Federal Government program “Strategic Investment Fund” at the tune of $2.5 million. The remaining of the funding is coming from CFI and University sources.

The Department’s mission and objectives are:

• To educate and train the best engineers for the materials and mining professions by offering two high-quality, accredited cooperative undergraduate programs.
• To educate and train graduate students and post-doctoral fellows in advanced research areas both in fundamental and applied fields of the respective disciplines.
• To conduct high-quality research of international standing in materials and mining engineering.
• To promote strong interaction with industry, other academic institutions and research centers through both cooperative education and industrial partnership in research.

2016 Milestones

• A 5-year strategic plan for the Materials Engineering program was developed and submitted to the Dean. The plan prepared by a Strategic Task Force (STF) led by the Chair was discussed in a retreat held in May 2016. The plan proposes departmental re-organization to see Mining becoming an autonomous unit and Materials evolving into the “Department of Materials Science & Engineering”.
• The Materials Academic Committee led by Associate Chair Chromik was successful in having our undergraduate program accredited by CEAB at the review taken place in November 2016.
• Professor Marta Cerruti’s Canada Research Chair, Tier 2 was renewed
• Professor George Demopoulos was appointed Gerald G. Hatch Chair Professor from January 2016 to December 2022.
• Professor Raynald Gauvin was awarded the Birks Chair in Metallurgy by the Faculty of Engineering and acquired the first in the world Scanning Electron Microscope with Electron Energy Loss Spectroscopy capability, the Hitachi SU-9000.
• Professor In-Ho Jung was appointed William Dawson Scholar
• Professional Engineering Licenses were obtained by Professor Showan Nazhat, Jun Song and Dr. Florence Paray.
• The Department welcomed a new Administrative Officer, Heather Holowathy and thanked Courtney Jelaco in a farewell reception for her 5 years of dedicated work as AA.
• The Department welcomed Monika Skonieczny as the new Mining Co-op Liaison Officer and Russel Wyse as the first Accounts Administrator, a new position created to handle the large volume of payroll appointments/transactions.

Research and Publications: 2016 Highlights

Department-wide total research funding in 2016 was $7.1 million ($1.4 million in mining and $5.7 million in materials). This translates to $338k/researcher—same level as last year. Notable is the high level of industrial research funding received at the level of $1.53 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 2016 there were active 20 CRD (6 New) and 10 SPG grants (4 New) led (as PIs) by members of our department. The following is a count, by category, of approx. 176 current grants

Operating Grants Held as Principal Investigator: 120 (including 40 new)
Professors as co-investigator: 42 (9 new)
Infrastructure Grants held: 14 (7 new)
Submitted grants during 2016: 44

New for 2016 – Major Research Grants:
• Brochu, Mathieu: CFI, JELF, Pulse Additive Manufacturing of Advanced Materials $979,000.00.
• Demopoulos, G. – NSERC STPGP grant with co-applicant Gauvin, R.. Development of light-chargeable lithium ion battery devices, total grant of $564,000.00.
• Guthrie, R. - NSERC STPGP grant, HSBC Casting of Thin Composite Sheet Metal Alloy Systems, total grant of $500,500.00
• Guthrie, R. – Innovee Research Grant – Production of sheet materials of aluminum and stell alloys for lightweighting of conventional and electrical autobodies, together with Soft Magnetic Lamellar Composites, for new lightweight electric motors, via the HSBC concept, total grant of $522,396.00.

For 2016, 188 peer-reviewed refereed journal papers (list is here: http://www.mcgill.ca/minmat/) were published by Departmental faculty (40 in Mining and 148 in Materials). This is an impressive output comparing to last year’s 157 total journal papers. 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/.
Finally, the faculty members were involved in over 80 invited presentations given in 2016 in conferences and institutions (refer to people pages at: http://www.mcgill.ca/minmat/). Notable invited presentations include:

- Bevan K., CMOS Emerging Technologies Research Symposium, Connecting Quantum Transport to Electrochemistry, Montreal QC (May 2016).
- Brochu M., Patchwork of additive manufacturing activities of P2AM2 laboratory, Additive Manufacturing Workshop Brussels, Belgium, May 26th, 2016. (Keynote)
- Dimitrakopoulos, R., Smart mining complexes and value chains: A technological perspective on risk management and sustainability, CIM Distinguished Lectures, presented at Laval University, University of Alberta, Management & Economics Society CIM, Vancouver, BC.
- Jung, I-H., Toward Virtual Steelmaking Plant-Thermodynamic/physical property databases and kinetic process simulations, 31th Distinguished speaker of Metallurgical Lecture, University of Science and Technology Beijing, Beijing, China, Sept. 22, 2016.
- Kumral M, “Remedial, bioremediation and engineering in mining industry and environment” from April 4–8, 2016 at ORT University in Montevideo, Uruguay.
- Mitri, H., Rock slope design, analysis, and monitoring. Presented at the University of Science and Technology Beijing (USTB) in May 2016.
- Sasmito A, Multiphysics modeling for sustainable mine energy system, Faculty Seminar, Shandong University of Science and Technology, Qingdao China, October 2016.
- Song J, Hydrogen adsorption at grain boundaries: a space-tessellation based structural analysis and chemomechanical origin of hydrogen trapping, Invited Talk at 12th World Congress on Computational Mechanix (WCCM XII) AND 6th ASIA-PACIFIC Congress on Computational Mechanics (APCOM VI), Seoul, Korea, July 2016
- Yue S., Steel, Mg, Cold Spray and Additive Manufacturing, Aviation Industry Corporation of China, May 2016.

**Teaching and Learning**

**Undergraduate programs & students:** Both academic programs, but more impressively Materials Engineering, have seen considerable growth over the past 7 years as the summary below highlights. Most of the U/G growth comes from international admissions (~50% of new students). This success creates challenges in maintaining our ability to provide full and meaningful co-op jobs. As a partial measure to address this challenge we were obliged to accommodate several of our co-op students in research trainee positions supervised by our professors or placing them in external to department academic labs. For example, in Materials out of 140 total placements in 2016 (102 new and 38 continuing) 38 were placed in MME labs and 7 in other ENG. Depts. At the same time, there were 74 co-op job placements in mining engineering (67 new and 7 continuing with 24% of the new jobs offered in MME labs through the SURE or MUST programs). In Mining at the initiative of its Director Hani Mitri, we launched the MUST (Mining Undergraduate Student Training) program that
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aims to raise funding from companies to support industry-related co-op jobs at McGill. Access to the CREATE program in aerospace offered by MIAE (McGill Inst. for Aerospace Engineering) directed by Professor Steve Yue as well as the Engineering SURE program provides additional co-op opportunities with a research focus. But in search of long-term sustainable solutions, both programs have moved to establish non-co-op streams, expected to receive approval next year.

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Based on data collected in an Engineering Career Centre grad survey soon after graduation of the 34 materials graduates (see Table above), 9 had chosen to continue in post-graduate studies, 16 were employed, 3 were seeking employment and 6 did not respond. These are good employment record figures reflecting in part the strong “hands-on” training our students receive through their co-op work terms.

Both the Materials and Mining undergraduate student societies were very active organizing academic fora, invited seminars and field trips and participating in conferences. Congratulations to Haixiang Sun, President of the McGill MetSoc Student Chapter and his team of Devin Hundt, Su Su, and Zapaer Alip in winning the MetSoc Video Challenge [GD1] contest at the 2016 COM/IMPC Meeting in Quebec City!

Graduate students and scholarships: Graduate student enrollment remained strong (Table). The breakdown in terms of graduate degree statistics in 2016 was: Mining: 22 PhD; 2 M.Sc.; 28 M.Eng. and Materials: 106 PhD; 2 M.Sc.; 41 M.Eng. The corresponding graduation statistics are: Mining: 1 M.Sc., 8 M.Eng and for Materials: 13 PhD, 1 M.Sc., and 12 M.Eng. The MEDA awards have provided much needed impetus in attracting Ph.D. students, over 23 new students in 2016. 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. PhD student Sara Imbriglio was awarded the Rio Tinto Alcan Scholarship and PhD student Emily Buck was awarded the Vanier Scholarship. The department’s Graduate Studies Committee recognizes graduate students for their research excellence. Medals or certificates and monetary prizes (approximately $49,000) were awarded based on a student’s overall research publication production while at McGill.

New or major continuing teaching initiatives:
• Prof. Bevan and Dr. Paray – Carried forward passage and implementation of new Departmental Graduate Safety course MIME 601.

Involvement in the Community

Highlights of community involvement include:
• Chromik, Richard: Symposium Chair, Tribology and Mechanical properties of Coatings and Thin Films.
• Dimitrakopoulos, Roussos: Executive Expert Advisory Board Member & Chair, EU Horizon 2020 Project: Real-Time Mining Consortium.
• Dimitrakopoulos, Roussos: Editor-in-Chief, Mathematical Geosciences.
• Jung, In-Ho: Associate Editor, CALPHAD Journal.
• Mitri, Hani: Member, Advisory Committee on Mines, Quebec Ministry of Energy and Natural Resources.

Honours, Awards, and Prizes

• Dimitrakopoulos R: Can. Inst. Mining, Metallurgy and Petroleum (CIM), “Distinguished Lecturer Award 2015-2016”: "In recognition of his distinguished contributions to research and teaching in strategic mine planning optimization”
• Jonas, J.J: Emeritus Professor Jonas was the recipient of prestigious 2016 Acta Materialia Gold Medal in recognition of his seminal contributions to understanding phase transformations and dynamic recrystallization in steel materials.
• Jung, I-H: World Famous Scientist Lecture Award, Hubei Province Government, China, September 2016

Other Highlights

• On January 12, 2016, retired Professor Philip A. Distin passed away. Phil had served the Department for 30 years from 1972 to 2002. The department is fortunate to receive a substantial donation from a former student of Professor Distin that will allow us to hold an annual event honoring his memory.

Respectfully submitted by

George P. Demopoulos

Date: August 30, 2017