

Institute for Materials Research

2007-2008 Annual Report to the Office of Research

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About IMR

The Ohio State University Institute for Materials Research (IMR) is an interdisciplinary organization established for the purpose of facilitating, promoting and coordinating research activities and infrastructure related to the science and engineering of materials throughout the University. IMR serves as the gateway to the materials research enterprise at The Ohio State University.

IMR VISION: A multidisciplinary research institute that propels OSU to the recognized international forefront of materials-allied research and scholarship.

IMR MISSION: To nurture, grow and support research groups leading to small, large and center-level awards; to provide strategic planning, resources, infrastructure, and educational/outreach activities; to coordinate, support and assist with management of campus-wide materials-allied research and related resources.

IMR Membership

IMR's membership includes over 120 faculty members and research staff representing 20 departments and 7 colleges. IMR members are faculty from the Colleges of Engineering; Mathematical and Physical Sciences; Food, Agricultural and Environmental Sciences; Biological Sciences; Medicine; Pharmacy; and Veterinary Medicine.

Faculty and Student Support

- IMR has supported 64 faculty members from 14 departments and 5 colleges with its first three internal grant award competitions (2007 and 2008 Faculty Grants and 2007 Interdisciplinary Materials Research Grants).
- The nine Interdisciplinary Materials Research Grants (IMRGs) awarded in 2007 provided full funding (salaries, fringe, and tuition and fees) for nine graduate students and postdoctoral researchers.
- 58 Ohio State students were sponsored by IMR to attend three strategic meetings: the 2007 and 2008 Ohio Nanotechnology Summits and the 2007 Center for Nanophase Materials Sciences Users Meeting.
- Four faculty members were sponsored by IMR to attend the 2007 Center for Nanophase Materials Sciences Users Meeting.

Major Accomplishments: IMR Highlights 2007 - 2008

Below is a list of highlights from IMR's first two full years of operations.

- Established a formal Battelle-IMR alliance designed to co-support early stage research tying Battelle and DOE mentors with IMR grad students.
- Led the Advanced Materials TIE proposal development and award to IMR, MAPS and COE (share to IMR core - \$2.09M; total OAA award - \$9.7M)
- Coordinated and assisted development of Targeted Faculty Cluster Hires related to the TIE award leading to up to 6 new faculty positions
 - Cluster hire in computational and multiscale materials: > 200 applicants for 4 interdisciplinary faculty positions: 2 accepted, 2 openings remain. The two TIE faculty hires joined OSU during academic year 2007-2008: J.C. Zhao, Associate Professor, Materials Science and Engineering and Sudarsanam Suresh Babu, Associate Professor, Industrial, Welding and Systems Engineering and Materials Science and Engineering
 - Cluster hire in electronic materials and photovoltaics: > 200 applicants for 2 jointly appointed positions in ECE and MSE departments, Assistant Professors Siddharth Rajan (ECE/MSE) and Roberto Myers (MSE/ECE), to join in Fall 2008.
- IMR guided development of 10 external major research proposals with total budget requests of \$82,832,347, not counting the proposals developed as a result of our seed grant funding to IMR faculty).
 - Of those 10 centrally-submitted proposals, three have been awarded totaling \$25,116,850:
 - Technology-Enabling and Emergent Materials, Ohio Research Scholars Program, Ohio Department of Development, PI: Steven Ringel, Institute for Materials Research, \$18,153,846 award; IMR coordinating statewide scholars cluster at 3 universities; inside OSU for 3 colleges (COE, MAPS, FAES)
 - Photovoltaics Innovation and Commercialization, Wright Center of Innovation program, University of Toledo (Ohio Department of Development award), PI: Robert Davis, Institute for Materials Research, \$6,813,004 award; IMR assisting coordination of 30 member companies, leading development of \$4M unique, open access facilities having a major benefit for NTWest as PVIC home; MAPS and COE

primary faculty members; IMRGs playing primary role in jumpstarting PVIC research

- Point Source Hydrogen Electrolysis to Enable MOCVD Development of III-V Solar Concentrator Cells, Edison Materials Technology Center, PI: John Carlin, Institute for Materials Research, \$150,000 award
- Two research proposals totaling \$21,261,619 are still pending:
 - Center for Emergent Materials, MRSEC proposal to National Science Foundation, \$18,261,619 budget; PI: Nitin Padture, Materials Science and Engineering; 3 IRGs; 14 MAPS, 11 COE faculty; most prestigious and competitive NSF award in materials (reverse site visit stage); 2 year continuous IMR effort; several components seeded by IMRG support
 - Thermodynamics: The Integrating Factor for Energy Conversion, IGERT pre-proposal to National Science Foundation, \$3,000,000 budget; PI: Hendrik Verweij, Materials Science and Engineering; 40 top graduate students; 16 MAPS and 14 COE faculty participants

Publications of Research Supported by IMR

Below is a list of 18 publications which have been reported to us by recipients of IMR funding through our 2007 Facility Grants and Interdisciplinary Materials Research Grants. Note that these are only those reported as directly attributed to these funds. However, a much larger number of publications has been developed by IMR affiliated faculty members who are receiving IMR support for their research.

Y. Zhao, et al. "Fabrication of Freeform Polymer Microstructures for Micromechanical and Microfluidic Applications," *Journal of Micromechanics and Microengineering*, in preparation.

K.C. Fong, Y. Che, P. Banerjee, Yu. Obukhov, D.V. Pelekhov and P.C. Hammel, "Manipulating Spins by Cantilever Synchronized Frequency Modulation: A Variable Resonance Force Microscope," *Applied Physics Letters*, in preparation.

S. Park, R. Yu, S. Chung, P.R. Berger, P.E. Thompson and P. Fay, "Sensitivity of Si-Based Zero-Bias Backward Diodes for Microwave Detection," *Electronics Letters*, 43, pp. 53-54 (March 1, 2007).

S. Piratla, S. Bechtel, M. Dapino, M. Mills, "Use of thermodynamic potentials for the fully-coupled characterization of thermo-electro-magneto-mechanical materials," International Journal of Engineering Science, in preparation.

M.H. Chisholm, P. Chou, Y. Chou, Y. Ghosh, T.L. Gustafson, M. Ho, "Preparations and Photophysical Properties of Fused and Non-Fused Thienyl Bridged MM (M=MO or W) Quadruply Bonded Complexes," *Inorganic Chemistry*, **47**, 3415-3425 (2008).

G.T. Burdzinski, M.H. Chisholm, P.-T. Chou, Y.-H. Chou, F. Fiel, J. C. Gallucci, Y. Ghosh, T. L. Gustafson, Mei-Lin Ho, Y. Liu, R. Ramnauth and C. Turro, "Oligothiophenes Incorporating Mo-Mo Quadruply Bonded Units: The Remarkable Influence of the M₂delta-Thienyl pi Conjugation," submitted to PNAS.

W.J. Yoon and P.R. Berger, "4.8% Efficient Poly (3-hexylthiophene)-Fullerene (1:00.8) Bulk Heterojunction Photovoltaic Devices with Plasma Treated AgO_x/ITO Anode Modification," *Applied Physics Letters*, **92**, 013306 (January 7, 2008). **Additionally, selected for republication in the January 21, 2008 issue of Virtual Journal of Nanoscale Science & Technology.**

M. Schuette and W. Lu, "Highly-selective zero-bias plasma etching of GaN over AlGa_{0.1}N, Journal of Vacuum Science Technology B," vol. 25, pp. 1870-1874, 2007.

S. Gupta, M. Elias, X. Wen, J. Shapiro, L. Brillson, W. Lu, and S. Lee, "AlGa_{0.1}N heterojunction field effect transistors for detection of clinically relevant MIG concentrations at physiological salt concentrations", *Biosensors and Bioelectronics*, Accepted.

X. Wen, J. Song, W. Lu, "Responses of AlGa_{0.1}N/GaN Heterojunction Field Effect Transistors to DNAs", *Journal of Science and Technology B*, Accepted.

X. Wen, S. Wang, L.J. Lee, and W. Lu, "AlGa_{0.1}N Heterostructure Field Transistor for Label-Free Detection of DNA Hybridization", *Biosensors and Bioelectronics*, submitted.

H. Kim, M.L. Schuette, J. Lee, W. Lu, and J.C. Mabon, "Passivation of Surface and Interface States in AlGa_{0.1}N/GaN HEMT Structures by Annealing", *Journal of Electronic Materials*, vol. 36, pp. 1149-1155, 2007

D. Liu, M. Hudait, Y. Lin, H. Kim, S.A. Ringel, and W. Lu "Gate length scaling study of InAlAs/InGaAs/InAsP composite channel HEMTs," *Solid State Electronics*, vol. 51, pp. 838-841, 2007.

H. Kim and W. Lu, "A simple model for extraction of effective trap density and gate length in AlGaIn/GaN high-electron mobility transistors based on pulse *I-V* characteristics", submitted to Applied Physics Letters.

D. Liu, M. Hudait, Y. Lin, H. Kim, S.A. Ringel, and W. Lu, "80nm InAlAs/InGaAs/InAsP Composite Channel HEMTs with an f_T of 280 GHz", submitted to Solid State Electronics.

B. Alexandrov and J.C. Lippold, "Non-equilibrium Phase Diagrams for Engineering Alloys, 50th Annual Assembly of IIW," Dubrovnik, Croatia, July 2007, IIW. Doc. II-A-181-07.

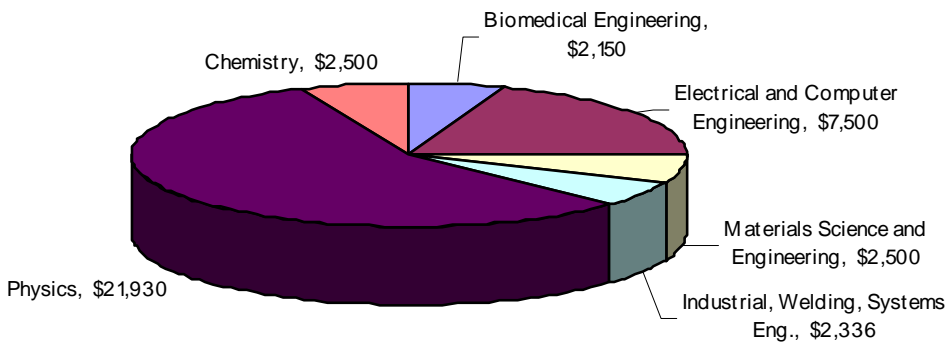
B. Alexandrov and J.C. Lippold, "Non-equilibrium Phase Diagrams in Advanced Engineering Alloys," to be published in Trends in Welding Research, Pain Mountain, GA, June 2008.

B. Alexandrov and J.C. Lippold, "Non-equilibrium Phase Transitions in Ni-base Super Alloys," to be published in Superalloys '08, Pittsburg, PA, September 2008.

IMR Awards Distribution 2007-2008

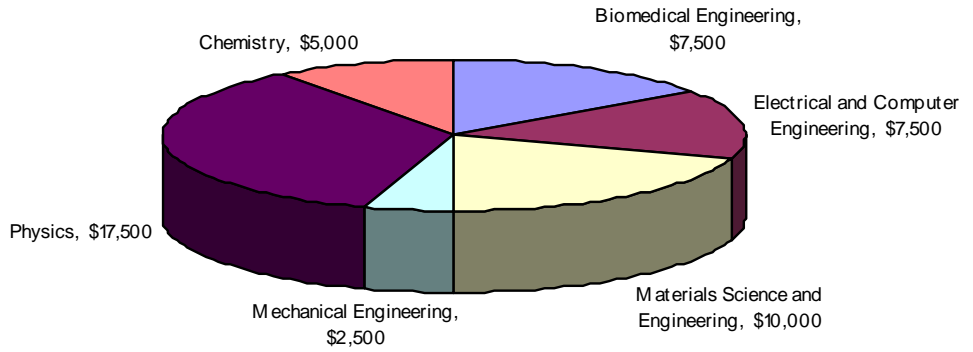
2007 Facility Grants

Department	# of Awards	Award Amounts
Biomedical Engineering	1	\$ 2,150
Electrical and Computer Engineering	3	\$ 7,500
Materials Science and Engineering	1	\$ 2,500
Industrial, Welding, Systems Eng.	1	\$ 2,336
Physics	9	\$21,930
Chemistry	1	\$ 2,500
Totals	16	\$ 38,916



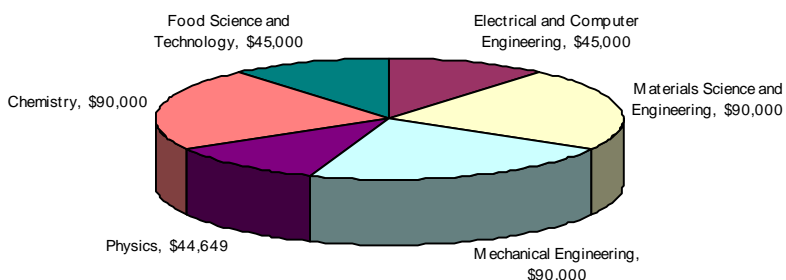
2008 Facility Grants

Department	# of Awards	Award Amounts
Biomedical Engineering	3	\$ 7,500
Electrical and Computer Engineering	3	\$ 7,500
Materials Science and Engineering	4	\$ 10,000
Mechanical Engineering	1	\$ 2,500
Physics	7	\$ 17,500
Chemistry	2	\$ 5,000
Totals	20	\$ 50,000



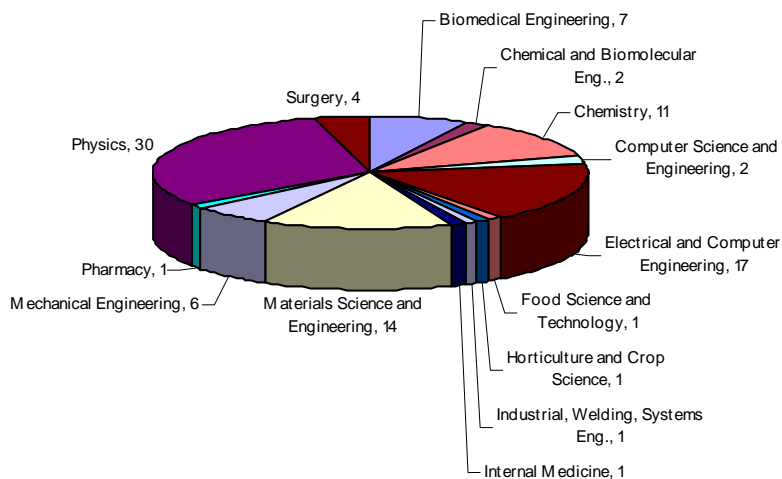
2007 IMRG Awards

Department	# of Awards	Award Amounts
Electrical and Computer Engineering	1	\$ 45,000
Materials Science and Engineering	2	\$ 90,000
Mechanical Engineering	2	\$ 90,000
Physics	1	\$ 44,649
Chemistry	2	\$ 90,000
Food Science and Technology	1	\$ 45,000
Totals	9	\$ 404,649



2007-2008 Facility Grants and IMRG Awards

Department	# of faculty investigators receiving award (PIs and Co-PIs)
Biomedical Engineering	7
Chemical and Biomolecular Eng.	2
Chemistry	11
Computer Science and Engineering	2
Electrical and Computer Engineering	17
Food Science and Technology	1
Horticulture and Crop Science	1
Industrial, Welding, Systems Eng.	1
Internal Medicine	1
Materials Science and Engineering	14
Mechanical Engineering	6
Pharmacy	1
Physics	30
Surgery	4
Totals	98



Note – 2008 Interdisciplinary Materials Research Grants (IMRGs) are pending

IMR Member List 9.2008

First Name	Last Name	Title	Department
Sudha	Agarwal	Professor	Orthopedics
Sheikh	Akbar	Professor	Materials Science and Engineering
Betty Lise	Anderson	Professor	Electrical and Computer Engineering
Peter	Anderson	Professor	Materials Science and Engineering
Sudarsanam		Associate Professor	Industrial, Welding and Systems Engineering
Suresh	Babu	Professor	
Stephen	Bechtel	Professor	Mechanical Engineering
Paul	Berger	Professor	Electrical and Computer Engineering
Bharat	Bhushan	Professor	Mechanical Engineering
Thomas	Blue	Professor	Mechanical Engineering
Dennis	Bong	Assistant Professor	Chemistry
Kim	Boyer	Professor	Electrical and Computer Engineering
Leonard	Brillson	Professor	Physics
Rudy	Buchheit	Professor	Materials Science and Engineering
Ralf	Bundschuh	Associate Professor	Physics
William	Carson	Professor	Surgery Oncology
Malcolm	Chisholm	IMR Associate Director	Chemistry
William	Clark	Professor	Materials Science and Engineering
James	Coe	Professor	Chemistry
Edward	Collings	Adjunct Professor	Materials Science and Engineering
Terry	Conlisk	Professor	Mechanical Engineering
Glen	Daehn	Professor	Materials Science and Engineering
Marcelo	Dapino	Associate Professor	Mechanical Engineering
Suliman	Dregia	Associate Professor	Materials Science and Engineering
Charles	Drummond	Associate Professor	Materials Science and Engineering
Prabir	Dutta	Fox Professor	Chemistry
Arthur	Epstein	Distinguished University Professor	Physics
Liang-Shih	Fan	Distinguished University Professor	Chemical and Biomolecular Engineering
Katharine	Flores	Assistant Professor	Materials Science and Engineering
Gerald	Frankel	Professor	Materials Science and Engineering
Hamish	Fraser	Professor	Materials Science and Engineering
Richard	Freeman	Professor	Physics
Somnath	Ghosh	Professor	Mechanical Engineering
Jianjun	Guan	Assistant Professor	Materials Science and Engineering
Jay	Gupta	Assistant Professor	Physics
Prabhat	Gupta	Professor	Materials Science and Engineering
Terry	Gustafson	Associate Professor	Chemistry
Christopher	Hammel	Professor	Physics

IMR Member List 9.2008

First Name	Last Name	Title	Department
Derek	Hansford	Associate Professor	Biomedical Engineering
Richard	Hart	Chair	Biomedical Engineering
Andrew	Heckler	Assistant Professor	Physics
Joseph	Heremans	Professor	Mechanical Engineering
Winston	Ho	Professor	Chemical and Biomolecular Engineering
Ezekiel	Johnston-Halperin	Assistant Professor	Physics
Kurt	Koelling	Professor	Chemical and Biomolecular Engineering
Ashok	Krishnamurthy	Associate Professor	Electrical and Computer Engineering
Gregory	Lafyatis	Associate Professor	Physics
John	Lannutti	Associate Professor	Materials Science and Engineering
Robert	Lee	Chair	Electrical and Computer Engineering
L. James	Lee	Professor	Chemical and Biomolecular Engineering
Stephen	Lee	Associate Professor	Biomedical Engineering
Thomas	Lemberger	Professor	Physics
Ju	Li	Assistant Professor	Materials Science and Engineering
John	Lippold	Professor	Industrial, Welding and Systems Engineering
Wu	Lu	Associate Professor	Electrical and Computer Engineering
Raghu	Machiraju	Associate Professor	Computer Science and Engineering
Edward	Martin	Professor	Surgery Oncology
Julia	Meyer	Assistant Professor	Physics
Terry	Miller	Professor	Chemistry
Michael	Mills	IMR Associate Director	Materials Science and Engineering
John	Morrall	Professor	Materials Science and Engineering
Patricia	Morris	Associate Professor	Materials Science and Engineering
Susan	Olesik	Professor	Chemistry
Michael	Ostrowski	Professor	Molecular and Cellular Biochemistry
Umit	Ozkan	Professor	Chemical and Biomolecular Engineering
Nitin	Padture	Professor	Materials Science and Engineering
Michael	Paulaitis	Professor	Chemical and Biomolecular Engineering
Jonathan	Pelz	Professor	Physics
Matthew	Platz	Distinguished University Professor	Chemistry
Steven	Povoski	Associate Professor	Surgery Oncology

IMR Member List 9.2008

First Name	Last Name	Title	Department
Heather	Powell		Materials Science and Engineering
Mohit	Randeria	Professor	Physics
Ronald	Reano	Assistant Professor	Electrical and Computer Engineering
David	Rigney	Faculty Emeritus	Materials Science and Engineering
Matthew	Ringel	Professor	
Steven	Ringel	Professor	Electrical and Computer Engineering
Giorgio	Rizzoni	Professor	Mechanical Engineering
Patrick	Roblin	Professor	Electrical and Computer Engineering
Thomas	Rosol	Dean	Vet Med Administration
Yogeshwar	Sahai	Professor	Materials Science and Engineering
Atom	Sarkar	Assistant Professor	Neurological Surgery
Ratnasingham	Soorykumar	Professor	Physics
Stephen	St. Martin	Professor	Horticulture and Crop Science
Doru	Stefanescu	Research Professor	Materials Science and Engineering
David	Stroud	Professor	Physics
Vishwanath	Subramaniam	Professor	Mechanical Engineering
Michael	Sumption	Adjunct Professor	Materials Science and Engineering
Duxin	Sun	Assistant Professor	
Richard	Swenson	Professor	Biochemistry Administration
Nandini	Trivedi	Professor	Physics
Claudia	Turro	Professor	Chemistry
George	Valco	Associate Professor	Electrical and Computer Engineering
Henk	Verweij	Professor	Materials Science and Engineering
Yael	Vodovotz	Associate Professor	Food Science & Technology
John	Volakis	Professor	Electrical and Computer Engineering
Robert	Wagoner	Professor	Materials Science and Engineering
Yunzhi	Wang	Professor	Materials Science and Engineering
Gregory	Washington	Professor	Mechanical Engineering
John	Wilkins	Professor	Physics
James	Williams	Professor	Materials Science and Engineering
Wolfgang	Windl	Associate Professor	Materials Science and Engineering
Patrick	Woodward	Associate Professor	Chemistry
Yiyang	Wu	Assistant Professor	Chemistry
Ronald	Xu	Assistant Professor	Biomedical Engineering
Fengyuan	Yang	Professor	Physics
Yi	Zhao	Assistant Professor	Biomedical Engineering
Ji-Cheng	Zhao		Materials Science and Engineering
Yuan	Zheng	Professor	Electrical and Computer Engineering