ANNUAL REPORT

for the

Institute of Materials Processing

University Research Center

Fiscal Year 2023

submitted to

The Vice President of Research
Michigan Technological University

Attn: Kathleen Halvorsen
Associate Vice President for Research Development

submitted by

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and

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1. MISSION STATEMENT

The IMP mission is to effectively support and promote a unique suite of materials processing facilities such that they will be functional and available to provide a competitive advantage for faculty-led research, to support instructional and outreach activities, and to enable a "maker-culture" for student creativity, prototyping, and entrepreneurship. Towards enhancing Michigan Tech's portfolio of materials processing capabilities, IMP is also motivated to assist and support other faculty and units in the establishment of new capabilities and material processing functionalities.

2. SUMMARY OF FY23 ACTIVITIES

Developed in FY23 and new for FY24, the governance and administration of IMP is guided by a charter. The charter describes the selection and duties of the director, qualifications for membership, resource (IRAD) allocation philosophy, and summarizes the strategic goals of the center. Specifically, an elected Director will serve 3-year term and administer the activities of the center, including allocation of resources (IRAD), recruiting, and reporting. The charter also formalizes qualification for membership as any Michigan Tech faculty or staff member who administers an IRAD-generating proposal through the center or is a significant participant (defined in the charter) on an externally funded grant. An affiliate membership level has been established to welcome other members of the university community that do not meet these qualifications but have an interest in materials processing and/or the facilities for non-research purposes (e.g., instruction, outreach, recruitment, etc.).

In FY23, IMP served its mission by supporting 52 Michigan Tech faculty and technical staff members in the execution of their research programs (see Appendix Table A-1), through pre-award proposal support, investments in new capabilities, and/or assisting with the maintenance of existing facilities to ensure continuing functionality. Of the 52 members, 12 represent new members relative to the FY22 member roster (44 members). Five members of the FY22 roster have since left the university (Guillory and Herbert) or have retired (Hwang, Moran, Anzalone). Two prior members have been dropped due to inactivity (Irwin, Rawashdeh). Invitations to learn more about the services IMP provides were extended to 7 new faculty members based on the content from their Tech Talk introduction on 8/16/23. Current membership in IMP is slightly higher (+13%) relative to historical 5-year average of approximately 45 members.

Significantly, IMP reliably and effectively provides pre-award support for proposals that are submitted through the center, and post-award via cost sharing facility use fees where they are used in the execution of an IMP-administered grant. Remaining funds are directed towards activities that will serve to sustain the use and functionality of the existing facilities (including maintenance contracts and high-cost and unplanned maintenance needs), the acquisition and establishment of new capabilities, and any activities that will serve increase the interdisciplinary user base of the facilities. IMP regularly contributes to yearly cost sharing requests from ACMAL to support yearly maintenance contracts, and to member requests for cost-share in support of an REF, MRI, or similar equipment-focused proposals.

IMP has also become central to the ongoing activities of the Advanced Materials and Manufacturing Tech Forward Initiative, and as the primary liaison to the LIFT national manufacturing laboratory in Detroit.

4. BUDGET OVERVIEW

Table I is a reconciliation summary of the IMP IRAD account (E35426) for FY23. Approximately 26% of the FY23 IRAD distribution was directed to pre-award staff support (Allison Hein), and 22% to facility use fee cost sharing (ACMAL MFF, and other use-fee facilities). IMP contributed $6K (≈ 8% of the FY23 budget) towards the yearly ACMAL maintenance contracts.

In addition to the pre- and post-award support described above, specific activities of note in FY23 involved contributions towards a variety of upgrades linked to materials processing facilities (direct chill casting, 3D

printing, wire electro-discharge machining (EDM), molten aluminum degassing). Contributions towards support of four staff members (Stein, Hein, Dewald, Meneguzzo) and temporary student co-ops (4 temporary employees) to implement and administer these upgrades were included. IMP provided stipend support to a graduate student pursuing opportunistic seed research in anticipation of a pending major proposal submission.

At least nine technical staff members (Dewald, Fraley, Freitas, Hein, Laitila, Miller, Seguin, Stein, Wood) direct charged all or a portion of their salary to IMP-administered projects. At least 20 graduate students receive funding from IMP projects in support of their thesis and/or dissertation.

Appendix Table A-2 lists FY23 proposals submissions that were administered through IMP; Table A-3 IMP's active external research grants in FY23 (Table A-3 does not include some projects that are shown in Table A-2, such as Various Sponsor confirming orders, student design projects, and gifts), and Figure A-1 the projected IRAD returns chart from ASPIRE.

IMP also continued its support of externally funded faculty and student research by providing cost share of the use fees charged to utilize the materials processing facilities, and any use fees necessary to subsequently characterize and certify the materials produced (e.g., ACMAL, mechanical testing). On externally funded IMP projects, this initiative pays 25% of the hours of use for ACMAL and IMP labs with use fees at the approved use rate from the IMP IRAD index.

5. FUTURE PLANS / GOALS

- IMP will continue to support the installation, development, and (occasionally, maintenance) of major materials processing facilities that are available to university faculty and staff for research.
- We are enthusiastic and optimistic about the three new hires in the MSE department that started in August 2023 with skill sets and interests that are directly tied to the material processing and characterization facilities that we have on campus currently, and that provide a path to a range of new and complementary facilities in the future that will expand the research capabilities at the university.
- IMP is looking forward to kicking off several new, large grants in FY24. For example, Lei Pan (ChE) has been notified of a DOE grant valued at $8.1M with approx. $1M cash matching from EGLE and the MEDC to begin this fall.
- IMP has initiated a search for a Research Coordinator staff position to assist with the increasing number of proposals that we are administering, and to expand the reach of our services to include additional post-award services, assistance with identifying grant opportunities, and marketing of IMP facilities and services. The staff position will be cost-shared with the MSE and GMES departments, and with the College of Engineering.
- IMP has been central to the recent reorganization and leadership shifts in the Advanced Materials and Manufacturing Tech Forward initiative. The Tech Forward working group is using the initiative to better define and market the significant activities in the AMM areas that exist across campus. The working group is seeking to establish more formal links among the various components that support the materials and manufacturing infrastructure on campus, including research, education, talent pipeline, and industry involvement. The TF WG recently launched a new website under a heading of the Institute of Advanced Materials and Manufacturing (IAMM) as a platform to summarize these activities (see http://www.mtu.edu/manufacturing).
- No space needs are anticipated. In its current method of operation (MO), IMP does not manage assigned space; rather, IMP supports facilities located in spaces assigned to other units (departments, colleges) in a partnering mode.

- IMP will continue support of processing and characterization use fee cost sharing in support of faculty research.
- IMP will continue to work with department chairs and college deans to assist with new faculty start-up packages that involve material processing.
- IMP will continue supporting proposal submissions and selected post-award activities.

TABLE I.

Institute of Materials Processing FY23 IRAD budget reconciliation.

Item	Amount	Notes
Carryforward from FY22	$ 13,967.31	
FY23 IRAD distributions	$ 76,816.25	
Facility upgrades		
Various facility upgrade purchases	$ (6,641.76)	DC Caster, Upgrading the CNC metal 3D printer, New EDM machine, and custom PBF print parameters. DC Caster, improved (Mark III) model of the aluminum degasser and minor furnace/ventilation improvements.
Use charge cost share	$ (17,263.68)	Cost share of materials processing and characterization facility use fees (e.g., facilities administered by MSE and ACMAL) for IMP members – 25% of the time used is paid by IMP
Labor / salaries		
Technical staff	$ (7,434.96)	Maintenance, facility oversight, tech services (Stein, Dewald, others)
Research staff	$ (20,032.00)	Proposal, project support (Hein)
Grad Student	$ (5,387.09)	Su23 stipend for S.Chen (Hu student)
Hrly grad/undergrad Students	$ (5,733.00)	Processing lab student co-ops
Fringe	$ (12,153.44)	
Laboratory maintenance and supplies	$ (1,253.60)	Assorted lab supplies and equipment maintenance
Memberships	$ (1,000.00)	LIFT annual membership
Travel	$ (48.66)	Travel, (Kampe business meals, LIFT?)
IMP cost share contributions	$ (6,000)	ACMAL – 2022 Maintenance agreements
	$ 795.38	Return CS from FY21 COVID project (Bowen Li E49557)
FY24 Carryforward	$ 8,630.75	

APPENDIX

Table A-1

Institute of Materials Processing membership, FY23

	College	Department	Name
1	Business	CoB	Jenny Apriesnig*
2	Business	CoB	Laura Connolly*
3	Business	CoB	Emanuel Xavier-Oliverira*
4	Engineering	BME	Bruce Lee
5			Jeremy Goldman
6		CEGE	Pasi Lautala
7		ChEng	Gerard Caneba
8			David Shonnard
9			Lei Pan
10			Rob Handler*
11			Ruiting Zhan
12			Tim Eisele
13			Rebecca Ong
14		ECE	Paul Bergstrom*
15		GMES	Snehamoy Chatterjee*
16			Matt Portfleet*
17		MEEM	Trisha Sain
18			Vinh Nyguyen*
19			Greg Odegard
20			Kazuya Tajiri
21			Parisa Abadi
22			Zequn Wang
23			Ezra-Bar Ziv*
24		MMET	David Labyak
25			Nick Hendrickson
26		MSE	Anjana Asthana
27			Bowen Li
28			Daniel Seguin
29			Edward Laitila
30			Allie Glover*
31			Erico Freitas
32			Elizabeth Miller
33			Jaroslaw Drelich
34			Larry Sutter
35			Paul Fraley
36			Paul Sanders
37			Josh Mueller*
38			Miguel Levy
39			Russ Stein
40			Steve Hackney
41			Steve Kampe
42			Thomas Wood
43			Timothy Leftwich
44			Walter Milligan
45			Yongmei Jin
46			Sriram Vijayen*
47			Yu Wang
48			Yun Hang Hu
49	Sciences & Arts	Physics	Ranjit Pati
50			Pat Heiden
51		Social Sciences	Jonathan Robins*
52			Stephen Techtman

* New member in AY20223 (13 of 52)

Table A-2
IMP Proposal Activity, FY23

PI	Title and Brief Description	Sponsor	Period	External Funding	Internal (MTU) Cost-Share	PIs (co-PIs)	Students/ Other Collaborators	MTU #	submission date	notes	Status
Bergstrom	Upper Midwest Microelectronics Innovation Hub	University of MN - DOD	2023-28	$499,960.00				2302052	2/17/23		declined
Bergstrom Total				$499,960.00							
Caneba	Novel High-Energy-Density Chain-Polymerization Reactions	DOE ARPA-E CREATE	2023-25	$500,000.00	$26,320.00			2303034	3/21/23		declined
Caneba	Novel Reactive Separation of Heavy Water Isotopes	NIH R21	2024-26	$313,000.00				2306025	6/16/23		withdrawn
Caneba Total				$813,000.00							
Drelich	Zn-based alloy of reduced fatigue and stress corrosion cracking for bioresorbable stents	UM - MSGC	2023-24	$5,000.00		Henry Summers (PI, MSE ugrad)		2211051	11/15/22		declined
Drelich Total				$5,000.00							
Fraley		KS Kolbenschmidt US	2022-23	$10,000.00				2104032P2	12/9/22	continuation CR SO	funded
Fraley	Materials Characterization and Analyses	Amsted Rail Company, Inc	2022-23	$15,000.00				2301032	1/23/23	NTE SO, invoice as work is done	funded
Fraley	Melt Spinning	Questek Innovations	2023	$7,200.00				2302070	2/23/23	rev - FFP SO: 6 tests @ $1200 ea, notify SPA when to bill	funded
Fraley Total				$32,200.00							
Freitas	TEM Analyses	Ford Motor Company	2022-23	$2,000.00				2212018	12/9/22	FFP SO	funded
Freitas	STEM Analyses	Aperam South America	2022-23	$16,900.00				2205042P2	1/23/23	supplement to current, revised budget	funded

Table A-2
IMP Proposal Activity, FY23

PI	Title and Brief Description	Sponsor	Period	External Funding	Internal (MTU) Cost-Share	PIs (co-PIs)	Students/ Other Collaborators	MTU #	submission date	notes	Status
Freitas	HRTEM analysis	University of Miami	2023	$890.00				2302072	2/23/23	FFP SO	
Freitas Total				$19,790.00							
Goldman	Suppression of neointimal hyperplasia and inflammation from degradable implants in diseased arteries	NIH R15 resub	2023-25	$469,500.00				2210061	10/25/22		declined
Goldman	Development of matrix-engineered vascular grafts	NIH R15	2023-25	$469,500.00				2210058	10/25/22		declined
Goldman	Acellular and Completely Biological Tissue Engineered Vascular Graft	TAMU NIH R01 resub	2023-27	$491,349.00				2210103	10/28/22		declined
Goldman	Interwoven Extracellular Matrix for Acellular Vascular Graft Engineering	TAMU NIH R01	2023-27	$491,349.00				2301054	1/27/23		declined
Goldman	Acellular and Completely Biological Tissue Engineered Vascular Graft	Texas A&M University - NIH R01 resubmission	2023-27	$575,383.00				2302075	2/24/23		declined
Goldman	Development of matrix-engineered vascular grafts	NIH R01	2024-28	$2,583,845.00			Technical University of Liberec (Czechia), OHSU	2306003	6/3/23		
Goldman Total				$5,080,926.00							
Hendrickson	Machining Samples	LIFT, Operated by ALMMII	2022-23	$17,511.00				2211033	12/5/22	CR SO	funded
Hendrickson Total				$17,511.00							
Hu	Synthesis of Highly Conductive Alkali-Metal-Embedded Carbon Nano Materials	NSF DMR:TMRP	2023-26	$471,386.00				2208025	8/15/22		declined

Table A-2
IMP Proposal Activity, FY23

PI	Title and Brief Description	Sponsor	Period	External Funding	Internal (MTU) Cost-Share	PIs (co-PIs)	Students/ Other Collaborators	MTU #	submission date	notes	Status
Hu	Highly Efficient Thermo-Photo Catalytic Steam Reforming of Methane to Value-added Compounds	DOE UCR AOI 4	2023-26	$499,991.00				2208017	8/25/22		declined
Hu	Structure transition and Chemical Reactivities of Atomic Carbon Chains	NSF CHE-DRP	2023-26	$477,624.00				2209085	9/30/22		declined
Hu	Thermally and Electrically Conductive Na-Embedded Amorphous Carbon Materials	DOE IEDO, Topic Area 3b, 2997-1591	3 years			Paul Sanders		2304033 PP	4/17/23	concept paper	encouraged
Hu	Thermally and Electrically Conductive Na-embedded Amorphous Carbon Materials	DOE IEDO	2024-26	$1,500,000.00	$375,000.00	Paul Sanders		2304033	6/23/23		
Hu Total				$2,949,001.00							
Labyak	Machinability of Solution Strengthened Ferritic Ductile Iron	American Foundry Society	2022-23	$35,000.00	$9,715.00	Paul Sanders (MSE)		2301011	1/9/23	research agreement	funded
Labyak Total				$35,000.00							
Laitila	Sample Analyses	Fairbanks Exploration Inc	2022-24	$10,000.00				2212017	12/12/22	NTE CR SO	funded
Laitila Total				$10,000.00							
Li	Enhancement of Asphalt Pavement with Surface Modified Basaltic Granules	MTRAC Adv Matls	2023-24	$31,494.00	$10,500.00	Paul Fraley		2304005	4/3/23		funded
Li Total				$31,494.00							

Table A-2
IMP Proposal Activity, FY23

PI	Title and Brief Description	Sponsor	Period	External Funding	Internal (MTU) Cost-Share	PIs (co-PIs)	Students/ Other Collaborators	MTU #	submission date	notes	Status
Miller	Material Characterization and Analyses	Magna Mirrors of America, Holland Mirrors Division	2022-23	$5,000.00				2209067	9/23/22	NTE SO	funded
Miller	Materials Characterization and Analyses	Magna Mirrors of America	2023	$5,000.00				2209067P2	2/23/23	NTE SO	withdrawn
Miller	Materials Characterization	ACAT Global	2023	$5,000.00			Ed Laitila, Erico Freitas	2305006	5/4/23	NTE SO	funded
Miller Total				$15,000.00							
Nyguyen	Improving the Curing Efficiency for Composite Aerostructures Through Multi-Task Optimization of a Physics-informed Multiple Neural Network Framework	Georgia Tech / DOE AMMO	2023-26	$283,090.00	$120,360.00			2304008	4/5/23		awarded, with revisions
Nyguyen Total				$283,090.00							
Pan	Supplying Refined Battery Materials into the United States Electric Vehicle Battery Supply Chain by Synergizing Lithium-ion Battery Recycling with Mine Waste Reclamation	US DOE EERE BIL VTO	2023-25	$8,137,783.00	$2,034,483.00	Tim Eisele (ChE), Laura Connolly (CoB), Jenny Apriesnig (CoB), Emanuel Oliveira (CoB)	Nion Metals, Ford, Eagle Mine, ANL, INL, MEDC, MTEC SmartZone	2205056	7/19/22		awarded - finally, start 10/1/2023
Pan	Energy Reduction and Improved Critical Mineral Recovery From Low-Grade Disseminated Sulphide Deposits and Mine Tailings	US DOE ARPA-E MINER	2023-25	$2,467,817.00	$129,978.00	Tim Eisele, Rob Handler, and Dave Shonnard (ChEng)	University of Utah, University of Nevada Reno, Eagle Mine, Polymet	2204031	7/25/22		funded
Pan	Nissan FY23 MTU Recycling Project Extension	Nissan North America	2022-23	$121,557.00				2007012P3	1/16/23		funded

Table A-2
IMP Proposal Activity, FY23

PI	Title and Brief Description	Sponsor	Period	External Funding	Internal (MTU) Cost-Share	PIs (co-PIs)	Students/ Other Collaborators	MTU #	submission date	notes	Status
Pan Total				$10,727,157.00							
Portfleet	Michigan Mine Safety and Health State Grants Training	US Department of Labor / MSHA	2022-23	$271,534.00	$67,884.00			2306018 24-0024	6/12/23	now in IMP	funded
Portfleet Total				$271,534.00							
Sanders	Casting Trials	Relativity Space	2022	$6,100.00			Tom Wood	2207055	8/2/22	FFP SO	funded
Sanders	Various Sponsor:Casting Trials	Waupaca Foundry	2022	$3,000.00			Dale Dewald	100368P22-2	8/4/22	FFP SO	
Sanders	Aluminum Critical Mineral Production via Landfill Mining: Environmental, community, and technical feasibility for integrated multi-material resource recovery	DOE UCR AOI 5	2023-26	$749,980.00		Jonathan Robins (SS), Tim Eisele (ChE), Rob Handler (ChE)		2208030	8/25/22		funded
Sanders	Melting Trials	Wieland Chase, LLC	2022	$16,000.00			Russ Stein	2208046	8/31/22	FFP SO: 60% due now, 40% due upon completion	funded
Sanders	Casting Torsional Fatigue samples	Cummins Technical Center	2022	$10,500.00			Dale Dewald	2209058	9/23/22	FFP SO	funded
Sanders	Research Support	Sunrise gift		$45,000.00				gift	11/7/22	half now, half April/May	funded
Sanders	Graduate Research Support	Sunrise gift		$55,000.00				gift	11/7/22	half now, half April/May	funded
Sanders	Optimized Traction Motor with Enhanced Winding Materials and Ultra-High Efficiency Lamination Cores	Secat, Inc / Robert Bosch Ltd / DOE VTO	2023-26	$400,000.00	$120,000.00		Tom Wood	2210099	11/8/22	AOI 3	declined

Table A-2
IMP Proposal Activity, FY23

PI	Title and Brief Description	Sponsor	Period	External Funding	Internal (MTU) Cost-Share	PIs (co-PIs)	Students/ Other Collaborators	MTU #	submission date	notes	Status
Sanders	Various Sponsor: Magnesium Alloy Extrusion trial	Terves Inc (for Magsorbeo)	2022-23	$3,600.00			Tom Wood	100368P22-3	11/30/22	VS FFP SO	funded
Sanders	supplemental funding	Wieland Chase, LLC	2022	$3,700.00			Russ Stein	2208046 mod1	11/30/22	add'l scope	funded
Sanders	LIFT Hypersonic - Phase 1	LIFT	2022-23	$90,000.00	$22,500.00	David Labyak (MMET)		2111035P1	12/2/22	research agreement	funded
Sanders	supplemental funding	Wieland Chase, LLC	2022-23	$3,000.00			Russ Stein	2206046 mod2	12/12/22	add'l scope	declined
Sanders	Characterization of microstructures and properties	Eck Industries	2022-23	$10,000.00			Tom Wood	2202005 mod1	12/12/22	continuation CR SO	funded
Sanders	LIFT Hypersonic - Phase 2	LIFT	2022-23	$55,000.00	$13,750.00	David Labyak (MMET)		2111035P2	1/3/23	research agreement	funded
Sanders	Machinability of Solution Strengthened Ferritic Ductile Iron	American Foundry Society	2022-23	$35,000.00	$9,715.00	David Labyak (PI, MMET)		2301011	1/9/23	research agreement	funded
Sanders	Magnesium Alloy Extrusion Trials	Magsorbeo Biomedical Corp	2023	$6,850.00			Tom Wood	2301052	1/25/23	FFP SO	funded
Sanders	Design of Aluminum Alloy, Geometry, and Process to Produce Turbines for Offshore Floating Wall Wind Power Concept	US DOE	2023-26				Sunrise Energy Metals	2302009 PP	2/3/23	concept paper	discouraged
Sanders	Research Support	CBMM North America, Inc	2023	$49,925.00			Dale Dewald, Russ Stein	2104043 P2	2/8/23	supplement to current	verbal funded, waiting for signatures
Sanders	Cost-Effective Tungsten 3% Rhenium Wire Fabrication for wide Range of Applications	Texas Biochemicals Inc / DOD STTR	2024	$350,000.00			Tom Wood	did not do officially	3/7/23		declined
Sanders	Casting Tortional Fatigue Samples	Cummins	2023	$6,200.00			Dale Dewald	2209058 P2	3/16/23	continuation FFP SO	funded
Sanders	Tensile Tests	Hydro	2023	$5,000.00			Pete Jaszczak	2303038	3/27/23	FFP SO	funded

Table A-2
IMP Proposal Activity, FY23

PI	Title and Brief Description	Sponsor	Period	External Funding	Internal (MTU) Cost-Share	PIs (co-PIs)	Students/ Other Collaborators	MTU #	submission date	notes	Status
Sanders	Wire Drawing and Analyses	Terves for DOE DE-FOA-0002864 (maybe)	2023-24	$9,550.00			Tom Wood	2304014	4/6/23	NTE SO	
Sanders	Tramp element reduction in scrap steel to decarbonize iron casting operations	DOE IEDO, Topic Area 5, 2997-1580	3 years				Waupaca Foundry - Jason Bush; Metal Technologies - Kramer Pursell; OmniSource - John Wassell; Elkem ASA - Leander Michels	2304034 PP	4/17/23	concept paper	encouraged
Sanders	Induction-heated kiln to decarbonize cement clinker production	DOE IEDO, Topic Area 7, 2997-1539	3 years			Larry Sutter	Interpower Induction (Gary Gariglio); Solidia Technologies (Doug Robinson)	2304032 PP	4/17/23	concept paper	discouraged
Sanders	Conformal Cold Spray Thermal Protection Coating for Artillery Projectiles	Binergy Scientific Inc / DOD STTR	2024	$60,000.00				2305048	6/1/23		declined
Sanders	Cold Spray Coatings for Sharp Hypersonic Leading Edges	Binergy Scientific Inc / DOD STTR	2024	$45,000.00				2305047	6/1/23		declined
Sanders	Tramp element reduction in scrap steel to decarbonize iron casting operations	DOE IEDO	2024-26	$2,482,000.00	$620,500.00		Waupaca Foundry - Jason Bush; Metal Technologies - Kramer Pursell; OmniSource - John Wassell; Elkem ASA - Leander Michels	2304034	6/23/23		
Sanders	Apply a Contemporary Steel Design Challenge (consistent strength throughout HSLA coil) as a Case Study in a Required MSE Course @ Michigan Tech…in place of 7075 aluminum!	AIST Steel Curriculum Development grant	2023-226	$25,000.00			Isabella W Jaszczak	gift	6/30/23	in IMP, $10k ea Yrs 1&2, $5k Yr3	funded

Table A-2
IMP Proposal Activity, FY23

PI	Title and Brief Description	Sponsor	Period	External Funding	Internal (MTU) Cost-Share	PIs (co-PIs)	Students/ Other Collaborators	MTU #	submission date	notes	Status
Sanders	Senior Design: Ceramic shot sleeve for ferrous HPDC	Mercury Marine	2022-23	$17,500.00	$9,586.00			2210040			funded
Sanders	Senior Design: Quantification and mitigation of boron from recycled steel in cast iron	Waupaca Foundry	2022-23	$17,500.00	$9,586.00			2209054			funded
Sanders	Senior Design: Microstructure and mechanical properties of AlMgSc filler alloy for wire arc additive manufacturing	Hobart Brothers LLC	2022-23	$17,500.00	$9,586.00			2210056			funded
Sanders	Senior Design: Die-casting alloy & process design for anodized aluminum cases	Amazon Lab126	2022-23	$17,500.00	$9,586.00			2210101			funded
Sanders	TEM	James Boileau		$7,750.00						gift	funded
Sanders	URP Weld Wires III	Ford Motor Company		$9,500.00						gift	funded
Sanders Total				$4,612,655.00							
Wood	Extrusion tests	Ames Lab (US DOE)	2022	$810.00				2111106P2	8/2/22	for overage	funded
Wood	Various Sponsor: Extrusion Trials	Orrvilon Inc	2023	$3,500.00				1206037 P23-1	3/2/23	VS FFP SO	funded
Wood Total				$4,310.00							
Grand Total				$25,407,628.00							

Table A-3
IMP Sponsored Programs, AY22

Michigan Tech University - 10/13/23
Financial Services and Operations
FZROPL002A Sponsored Prog Summ by FinMgr and Index
Fiscal Year: 2023, As of: 06/30/2023
College or Department: %, Index Term Date: June 30 2022, Index Title: %-IMP-%, Financial Manager: %

Financial Manager	Grant Title	Start Date	End Date	YTD Activity for Current Year	Budget	Project To Date Expenditures	Encumbrance	Balance
Asthana, Anjana	REF-FY19-IMP-STM/NI-S/TEM	07/01/2018	09/30/2023	14,825.72	33,600.00	31,917.54	.00	1,682.46
Subtotal: Asthana, Anjana				14,825.72	33,600.00	31,917.54	.00	1,682.46
Drelich, Jaroslaw W.	NIH-IMP-Bioabsorbable Stents	06/15/2019	05/31/2024	15,542.28	220,661.00	221,620.48	.00	-959.48
Drelich, Jaroslaw W.	NIH-IMP-Bioabsorbable Stents	06/15/2019	05/31/2024	30,942.89	210,891.00	91,651.22	.00	119,239.78
Drelich, Jaroslaw W.	OREGO-IMP-Biodegradable Metal	04/12/2023	03/31/2024	.00	171,568.00	.00	.00	171,568.00
Subtotal: Drelich, Jaroslaw W.				46,485.17	603,120.00	313,271.70	.00	289,848.30
Eisele, Timothy C.	USENE-IMP-Energy Reduction Mineral	01/01/2023	01/30/2026	1,395.00	31,104.00	1,395.00	.00	29,709.00
Eisele, Timothy C.	USENE-IMP-Energy Reduction Mineral	01/01/2023	01/30/2026	7,231.41	240,390.00	7,231.41	.00	233,158.59
Eisele, Timothy C.	USENE-IMP-FNR-Landfill Mining	04/01/2023	03/31/2026	.00	307,311.00	.00	.00	307,311.00
Subtotal: Eisele, Timothy C.				8,626.41	578,805.00	8,626.41	.00	570,178.59
Fraga Freitas, Erico Tadeu	APERA-IMP-STEM analyses	06/01/2022	12/31/2023	10,200.00	10,200.00	10,200.00	.00	.00
Fraga Freitas, Erico Tadeu	FORDM-IMP-TEM Analyses	12/15/2022	06/15/2023	1,413.87	2,000.00	1,413.87	.00	586.13
Fraga Freitas, Erico Tadeu	APERA-IMP-STEM Analyses	06/01/2022	12/31/2023	890.93	16,900.00	890.93	.00	16,009.07
Subtotal: Fraga Freitas, Erico Tadeu				12,504.80	29,100.00	12,504.80	.00	16,595.20
Fraley, Paul D.	GSENG-IMP-Testing	11/15/2021	11/14/2022	661.09	1,500.00	1,500.00	.00	.00
Fraley, Paul D.	GSENG-IMP-Testing	11/15/2021	12/30/2022	138.05	1,200.00	1,200.00	.00	.00
Fraley, Paul D.	AMSTE-IMP-Material Characterization	12/01/2022	12/31/2023	3,092.02	15,000.00	3,092.02	.00	11,907.98
Fraley, Paul D.	NANOA-IMP-Processing & Character	07/01/2021	06/30/2023	.00	20,000.00	10,292.27	.00	9,707.73
Fraley, Paul D.	KSKOL-IMP-Rotary Bend Fatigue Test	08/01/2021	12/31/2023	14,092.10	28,400.00	26,004.84	.00	2,395.16
Fraley, Paul D.	QUEST-IMP-Meltspinning	10/18/2021	03/15/2022	38.35	3,900.00	3,900.00	.00	.00
Fraley, Paul D.	NEUVO-IMP-MISC TESTING	01/01/2022	12/31/2023	9,280.50	10,000.00	10,682.22	.00	-682.22
Fraley, Paul D.	ORBIO-IMP-	06/27/2022	06/30/2023	3,431.59	5,000.00	3,431.59	.00	1,568.41
Fraley, Paul D.	QUEST-IMP-Melt Spinning	02/15/2023	12/31/2023	6,148.04	7,200.00	6,148.04	.00	1,051.96
Subtotal: Fraley, Paul D.				36,881.74	92,200.00	66,250.98	.00	25,949.02
Goldman, Jeremy	NIH-IMP-Bioabsorbable Stents	06/15/2019	05/31/2024	27,305.91	157,549.00	157,549.00	.00	.00

Table A-3
IMP Sponsored Programs, AY22

Financial Manager	Grant Title	Start Date	End Date	YTD Activity for Current Year	Budget	Project To Date Expenditures	Encumbrance	Balance
Goldman, Jeremy	CORIS-IMP-Sample Testing	07/01/2022	09/30/2022	15,000.00	15,000.00	15,000.00	.00	.00
Goldman, Jeremy	OREGO-IMP-Biodegradable Metal	04/12/2023	03/31/2024	7,124.46	110,200.00	7,124.46	.00	103,075.54
Subtotal: Goldman, Jeremy				49,430.37	282,749.00	179,673.46	.00	103,075.54
Guillory, Roger J.	NIH-IMP-Bioresorbable Magnesium	03/01/2023	02/28/2026	125,886.80	469,500.00	125,886.80	.00	343,613.20
Subtotal: Guillory, Roger J.				125,886.80	469,500.00	125,886.80	.00	343,613.20
Handler, Robert M.	USENE-IMP-Energy Reduction Mineral	01/01/2023	01/30/2026	.00	168,219.00	.00	.00	168,219.00
Handler, Robert M.	USENE-IMP-FNR-Landfill Mining	04/01/2023	03/31/2026	.00	69,304.00	.00	.00	69,304.00
Subtotal: Handler, Robert M.				.00	237,523.00	.00	.00	237,523.00
Hendrickson, Nicholas V.	LIFTT-IMP-Machining Samples	11/01/2022	10/31/2023	13,460.71	17,511.00	13,460.71	.00	4,050.29
Subtotal: Hendrickson, Nicholas V.				13,460.71	17,511.00	13,460.71	.00	4,050.29
Herbert, Erik G.	NSF-IMP-GOALI:Mechanically Stable	08/01/2022	07/31/2025	22,013.77	535,317.00	22,013.77	.00	513,303.23
Herbert, Erik G.	UTBAT-IMP-Solid-State Batteries	04/28/2022	12/31/2026	35,266.80	500,000.00	71,846.09	.00	428,153.91
Subtotal: Herbert, Erik G.				57,280.57	1,035,317.00	93,859.86	.00	941,457.14
Hu, Yun Hang	AMERI-IMP-Atomic Carbon Chains	08/01/2019	08/31/2022	4,907.42	110,000.00	110,000.00	.00	.00
Subtotal: Hu, Yun Hang				4,907.42	110,000.00	110,000.00	.00	.00
Jin, Yongmei M.	NSF-IMP-NSF-BSF:Computation	02/01/2023	01/31/2026	12,163.66	331,512.00	12,163.66	.00	319,348.34
Subtotal: Jin, Yongmei M.				12,163.66	331,512.00	12,163.66	.00	319,348.34
Kampe, Stephen L.	GENER-IMP-Melt Spin Processing	01/27/2022	11/30/2022	38,950.48	55,086.00	55,086.00	.00	.00
Subtotal: Kampe, Stephen L.				38,950.48	55,086.00	55,086.00	.00	.00
Labyak, David M.	AMERI-IMP-Machinability Ferritic Ir	11/07/2022	12/08/2023	16,951.99	35,000.00	16,951.99	.00	18,048.01
Labyak, David M.	LIFTT-IMP-Hypersonic Thermal	10/24/2022	06/30/2023	25,839.90	38,056.00	25,839.90	.00	12,216.10
Labyak, David M.	LIFTT-IMP-Phase 2 Hypersonic Therma	12/08/2022	12/31/2023	.00	17,908.00	.00	.00	17,908.00
Labyak, David M.	LIFTT-IMP-Hypersonic Thermal	10/24/2022	06/30/2023	7,676.82	7,679.00	7,676.82	.00	2.18
Labyak, David M.	LIFTT-IMP-Phase 2 Hypersonic Therma	12/08/2022	12/31/2023	3,598.47	4,798.00	3,598.47	.00	1,199.53
Subtotal: Labyak, David M.				54,067.18	103,441.00	54,067.18	.00	49,373.82
Laitila, Edward A.	FAIRB-IMP-Sample Analyses	12/01/2022	11/30/2024	3,116.70	10,000.00	3,116.70	.00	6,883.30
Subtotal: Laitila, Edward A.				3,116.70	10,000.00	3,116.70	.00	6,883.30
Lee, Bruce P.	OFFIC-IMP-Environ Scanning Microsco	04/01/2023	03/31/2024	.00	804,990.00	.00	.00	804,990.00
Lee, Bruce P.	NSF-IMP-DMREF/Collab Rsch:Adhesion	09/01/2021	08/31/2025	93,803.56	469,354.00	191,281.50	.00	278,072.50
Subtotal: Lee, Bruce P.				93,803.56	1,274,344.00	191,281.50	.00	1,083,062.50
Miller, Elizabeth A.	ICONT-IMP-Analyses and Testing	04/04/2022	06/30/2024	415.92	5,000.00	3,546.17	.00	1,453.83
Miller, Elizabeth A.	ICONT-IMP-Analyses and Testing	07/01/2022	06/30/2024	1,645.99	10,000.00	1,645.99	.00	8,354.01
Miller, Elizabeth A.	ACATG-IMP-Material Characterization	04/24/2023	08/31/2023	2,183.95	5,000.00	2,183.95	.00	2,816.05

Table A-3
IMP Sponsored Programs, AY22

Financial Manager	Grant Title	Start Date	End Date	YTD Activity for Current Year	Budget	Project To Date Expenditures	Encumbrance	Balance
Miller, Elizabeth A.	MAGNA-IMP-Material Charac & Analyse	09/22/2022	06/30/2023	6,161.70	5,000.00	6,161.70	.00	-1,161.70
Miller, Elizabeth A.	UPPER-IMP-Materials Analyses	01/01/2022	12/31/2022	3,253.56	4,237.79	4,237.79	.00	.00
Subtotal: Miller, Elizabeth A.				13,661.12	29,237.79	17,775.60	.00	11,462.19
Pan, Lei	USENE-IMP-Energy Reduction Mineral	01/01/2023	01/30/2026	1,395.00	23,901.00	1,395.00	.00	22,506.00
Pan, Lei	USENE-IMP-Energy Reduction Mineral	01/01/2023	01/30/2026	116,221.83	1,928,694.00	116,221.83	966,757.95	845,714.22
Pan, Lei	USENE-IMP-Energy Reduction Mineral	01/01/2023	01/30/2026	3,980.51	96,519.00	3,980.51	.00	92,538.49
Pan, Lei	CENTE-IMP-Respirable Coal Mine Dust	09/15/2022	09/14/2024	34,246.07	140,000.00	34,246.07	55,378.52	50,375.41
Pan, Lei	EAGLE-IMP-Extraction of Battery Met	09/01/2022	08/31/2023	16,449.55	20,000.00	16,449.55	.00	3,550.45
Pan, Lei	NISSA-IMP-Used Leaf Batteries	10/01/2020	12/20/2023	110,018.27	356,854.00	288,564.60	.00	68,289.40
Pan, Lei	MICHI-MTRAC-Hub 5 Advanced Material	07/01/2022	02/28/2024	20,467.91	50,000.00	20,467.91	.00	29,532.09
Subtotal: Pan, Lei				302,779.14	2,615,968.00	481,325.47	1,022,136.47	1,112,506.06
Pati, Ranjit	NSF-IMP-NSF-BSF:Computation	02/01/2023	01/31/2026	21,839.27	260,990.00	21,839.27	.00	239,150.73
Subtotal: Pati, Ranjit				21,839.27	260,990.00	21,839.27	.00	239,150.73
Pearce, Joshua M.	RE:3D-IMP-Increasing Maker Manufact	08/12/2019	03/31/2024	.00	260,000.00	174,475.10	.00	85,524.90
Subtotal: Pearce, Joshua M.				.00	260,000.00	174,475.10	.00	85,524.90
Robins, Jonathan E.	USENE-IMP-FNR-Landfill Mining	04/01/2023	03/31/2026	9,703.82	166,575.00	9,703.82	.00	156,871.18
Subtotal: Robins, Jonathan E.				9,703.82	166,575.00	9,703.82	.00	156,871.18
Sanders, Paul G.	USENE-IMP-FNR-Rapid Bayesian	07/01/2020	09/30/2024	80,518.46	277,020.00	274,309.47	2,967.76	-257.23
Sanders, Paul G.	USENE-IMP-FNR-Rapid Bayesian	07/01/2020	09/30/2024	42,747.53	222,980.00	72,855.97	106,139.00	43,985.03
Sanders, Paul G.	USENE-IMP-FNR Supply Chain	09/03/2021	09/02/2024	49,938.34	297,813.00	95,286.91	32,176.63	170,349.46
Sanders, Paul G.	USENE-IMP-FNR-Landfill Mining	04/01/2023	03/31/2026	2,067.36	131,316.00	2,067.36	.00	129,248.64
Sanders, Paul G.	USENE-IMP-FNR-Landfill Mining	04/01/2023	03/31/2026	3,756.00	75,474.00	3,756.00	.00	71,718.00
Sanders, Paul G.	USTRA-IMP-WAAM Weld Knuckles	04/08/2022	12/27/2024	90,089.78	500,000.00	90,464.08	.00	409,535.92
Sanders, Paul G.	AMERI-IMP-ICME Tools in Casting	08/30/2018	01/29/2023	19,150.64	125,000.00	125,000.00	.00	.00
Sanders, Paul G.	CUMMI-IMP-Wear Resistance Ductile	01/01/2019	12/31/2024	14,958.15	100,000.00	87,701.24	.00	12,298.76
Sanders, Paul G.	CBMMT-IMP-Research Support	12/01/2021	11/30/2023	112,393.17	119,925.00	122,123.52	244.84	-2,443.36
Sanders, Paul G.	ECKIN-IMP-Microstructure&Properties	01/01/2022	12/31/2023	20,925.42	35,000.00	35,083.84	.00	-83.84
Sanders, Paul G.	EPFLM-IMP-Copper Casting	05/15/2022	12/31/2022	366.91	1,986.00	1,986.00	.00	.00
Sanders, Paul G.	CUMMI-IMP-Casting Torsional Fatigue	09/01/2022	12/31/2023	12,195.23	16,700.00	12,195.23	.00	4,504.77
Sanders, Paul G.	FORDM-IMP-Hot Stamped 7XXX AL Sheet	03/01/2017	06/30/2023	19,678.24	200,000.00	200,976.46	.00	-976.46
Sanders, Paul G.	GENER-IMP-FNR-Low Mass&High Efficie	01/01/2020	12/31/2023	39,457.61	360,929.00	341,142.19	8,700.00	11,086.81
Sanders, Paul G.	IIVI-IMP-FNR-Processing & Analyses	05/01/2021	06/30/2022	1.34	13,800.00	13,800.00	.00	.00
Sanders, Paul G.	HARRI-IMP-Casting Trial	05/15/2022	07/31/2022	3,731.20	3,800.00	3,800.00	.00	.00

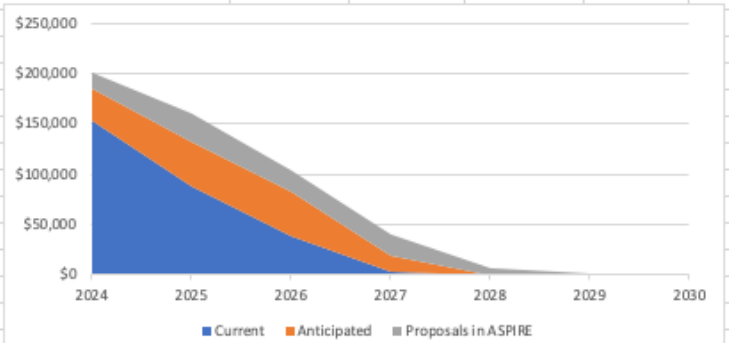
Table A-3
IMP Sponsored Programs, AY22

Financial Manager	Grant Title	Start Date	End Date	YTD Activity for Current Year	Budget	Project To Date Expenditures	Encumbrance	Balance
Sanders, Paul G.	HYDRO-IMP-Tensile Tests	03/15/2023	12/31/2023	632.56	5,000.00	632.56	.00	4,367.44
Sanders, Paul G.	LORAM-IMP-Grind Wheel Ph 1 Rv 2	05/01/2022	04/30/2024	62,968.41	122,400.00	62,968.41	.00	59,431.59
Sanders, Paul G.	LIFTT-IMP-Support ICME Design	04/01/2022	12/31/2022	50,000.00	50,000.00	50,000.00	.00	.00
Sanders, Paul G.	LIFTT-IMP-Hypersonic Thermal	10/24/2022	06/30/2023	44,769.36	51,944.00	44,769.36	.00	7,174.64
Sanders, Paul G.	LIFTT-IMP-Phase 2 Hypersonic Therma	12/08/2022	12/31/2023	6,409.30	37,092.00	6,409.30	.00	30,682.70
Sanders, Paul G.	LINCO-IMP-Producing and Testing Mat	09/15/2022	09/14/2023	18,732.23	75,000.00	18,732.23	.00	56,267.77
Sanders, Paul G.	MAGSO-IMP-Magnesium Alloy Extrusion	01/23/2023	04/01/2023	6,850.00	6,850.00	6,850.00	.00	.00
Sanders, Paul G.	RELAT-IMP-WAAM Alloy Development	05/01/2022	12/31/2023	129,275.33	156,000.00	139,164.43	.00	16,835.57
Sanders, Paul G.	RELAT-IMP-Casting Trials	07/29/2022	12/31/2022	6,100.00	6,100.00	6,100.00	.00	.00
Sanders, Paul G.	SUNRI-IMP-Alloy Compositions	01/01/2022	08/31/2022	4,981.77	20,000.00	20,000.00	.00	.00
Sanders, Paul G.	UNIVE-IMP-Extrusion Process Innovat	07/15/2021	06/30/2024	4,816.79	16,074.00	6,354.80	.00	9,719.20
Sanders, Paul G.	WIELA-IMP-Melting Trials	10/01/2022	01/31/2023	19,700.00	19,700.00	19,700.00	.00	.00
Sanders, Paul G.	AMERI-IMP-ICME Tools in Casting	08/30/2018	01/29/2023	9,767.09	61,570.00	61,570.00	.00	.00
Sanders, Paul G.	LIFTT-IMP-Support ICME Design	04/01/2022	12/31/2022	17,800.00	17,800.00	17,800.00	.00	.00
Sanders, Paul G.	LIFTT-IMP-Hypersonic Thermal	10/24/2022	06/30/2023	14,820.62	14,821.00	14,820.62	.00	.38
Sanders, Paul G.	LIFTT-IMP-Phase 2 Hypersonic Therma	12/08/2022	12/31/2023	6,714.01	8,952.00	6,714.01	.00	2,237.99
Subtotal: Sanders, Paul G.				916,312.85	3,151,046.00	1,965,133.99	150,228.23	1,035,683.78
Seguin, Daniel J.	MIRUS-IMP-Alloy Production & Analys	02/22/2021	06/30/2022	106.53	10,714.32	10,714.32	.00	.00
Subtotal: Seguin, Daniel J.				106.53	10,714.32	10,714.32	.00	.00
Shonnard, David R.	USENE-IMP-Energy Reduction Mineral	01/01/2023	01/30/2026	2,325.58	33,995.00	2,325.58	.00	31,669.42
Subtotal: Shonnard, David R.				2,325.58	33,995.00	2,325.58	.00	31,669.42
Stein, Russell E.	LIFTT-IMP-Low Cost 3-D Printing	08/01/2021	07/31/2022	3,654.88	10,000.00	10,000.00	.00	.00
Stein, Russell E.	UNIVE-IMP-3-D Printing Die Casting	08/01/2021	09/30/2022	19,285.18	84,045.53	84,045.53	.00	.00
Stein, Russell E.	UNIVE-IMP-3-D Printing Die Casting	08/01/2021	09/30/2022	420.26	10,500.00	10,500.00	.00	.00
Subtotal: Stein, Russell E.				23,360.32	104,545.53	104,545.53	.00	.00
Wang, Zequn	USENE-IMP-FNR Supply Chain	09/03/2021	09/02/2024	63,118.36	102,187.00	103,665.19	.00	-1,478.19
Subtotal: Wang, Zequn				63,118.36	102,187.00	103,665.19	.00	-1,478.19
Wood, Thomas D.	AMESL-IMP-Extrusion Trials	12/01/2021	12/31/2022	-.02	6,810.00	6,810.00	.00	.00
Wood, Thomas D.	LOUKU-IMP-Processing, Testing & Ana	11/01/2020	06/30/2022	.00	12,372.49	12,372.49	.00	.00
Wood, Thomas D.	LOUKU-IMP-Processing, Testing & Ana	01/01/2022	12/31/2024	23,062.45	25,000.00	29,701.53	.00	-4,701.53
Subtotal: Wood, Thomas D.				23,062.43	44,182.49	48,884.02	.00	-4,701.53
TOTAL				1,948,660.71	12,043,249.13	4,211,555.19	1,172,364.70	6,659,329.24

Figure A-4
Projected IMP IRAD, from ASPIRE

Source: ASPIRE on 07/18/2023

Projected IMP IRAD Based on ASPIRE Information



	2024	2025	2026	2027	2028	2029	2030
Proposals in ASPIRE	$15,806	$27,612	$22,340	$20,069	$5,803	$445	$0
Anticipated	$31,500	$44,331	$42,995	$16,844	$0	$0	$0
Current	$153,760	$88,213	$39,030	$2,821	$0	$0	$0

	IMP return	0.155								
	Current awarded net ICR	992,000	569,118	251,805	18,200	-			1,831,123	
	Anticipated Net ICR	186,555	186,324	179,679	28,449	-			581,007	
	Proposals Net ICR	101,973	178,144	144,128	129,479	37,437	2,873		594,034	1,175,041
									3,006,164	
	*anticipated awards - subtract from Proposals except for Goldman (***which isn't in Proposals) - estimated but ASPIRE amts do not seem to reflect actual award (?)									
	Pan - DOE BIL, #2205056	131,507	156,246	156,246	24,739					
	Pan - Eagle Mine, #2306073	4,384	5,208	5,208	825					
	Pan - MEDC, #2306074	15,340	18,225	18,225	2,886					
	Li - MTRAC, #2304005	13,362	2,513							
	Portfleet - DOL, #2306018	21,963	4,132							
	subtract from Proposals	**186,555**	**186,324**	**179,679**	**28,449**				**581,007**	
***	Goldman/Drelich OHSU yrs2-4	16,670	99,682	97,709	80,224					

Research Projection Report for IMP.....from department Research Projection Report, click on Start Over and select IMP

See file: for FY23 report IMP IRAD info from ASPIRE

* anticipated amounts are calculated but I'm not sure at all that I'm doing the correct calculation to get these figures.

Institute of Materials Processing

Serious Makerspace

Michigan Tech

Introduction

Abstract

The Institute for Material Processing (IMP) provides, maintains, and encourages partnerships for the use of facilities supporting synthesis, processing, and the manufacture of a wide range of engineering materials and product prototypes. IMP-maintained capabilities include several melt processing variants, various deformation-processing strategies, particulate (powder)-based methods, and emerging capabilities in metal-based additive manufacturing. The facilities support a wide range of university activities, including production of advanced and experimental materials for faculty-led research, advanced process development, support of instructional labs, interdisciplinary collaboration, and outreach. When coupled with the university's core Microfabrication Facility (MFF) and the Advanced Characterization and Morphological Analysis Laboratories (ACMAL), Michigan Tech's suite of material processing and complementing characterization facilities represent an impressive breadth of capabilities enabling advanced in-house experimentation, discovery, and development at a level and scale that is unique among universities nationally and internationally.

History of IMP

The Institute of Mineral Research (IMR) was founded in 1955 to assist the mining industries in the State of Michigan as a state-funded, dedicated research institute with a non-academic staff of research scientists and engineers. IMR was the initial occupant of Benedict Labs, adjacent to the Minerals and Materials Building. In 1988, the Institute was renamed as the Institute of Materials Processing (IMP), in recognition of its expanded role that included other materials industries, notably steel making, ceramic and composite processing, and near net-shape manufacturing. In 2010, IMP merged with the Institute of Engineered Materials (IEM), further broadening its scope to include processing-engineered functional materials.

Research

Capabilities

Melt Processing (metals)
- Induction melting (Fe-, Al-alloys)
- Vacuum induction melting (Al-, Mg-, Cu-alloys)
- Resistance melting (Cu-, Al-alloys)
- Investment casting (Al-, Cu-alloys)
- Melt-spinning (rapidly solidified metals)
- Arc melting (esp. refractory metals)

plus supporting molding, pattern-making, analysis, and finishing facilities

Deformation processing (metals)
- Breda 550 ton extrusion press
- FENN 8-in rolling mill
- FENN rotary swager
- Wire-drawing

plus supporting heat treatment and finishing facilities

Particulate (powder) processing (metals, ceramics)
- ASEA Mini-hot isostatic press (metals, ceramics)
- AVS vacuum hot press (metals, ceramics)
- Cold isostatic press (metals)
- Dake 150-ton unidirectional press (metals, ceramics)

plus supporting powder blending and preparation, canning, environmental glove boxes, sintering and heat treatment, and characterization facilities

Metallic 3D printing (Additive Manufacturing)
- Low-cost, wire-fed GMAW process development
- Laser fusion process development (REF pending)

ALIFT · ONR · U.S. DEPARTMENT OF ENERGY · BENTELER · America Makes · MDOT · Ford · NSF

Instruction & Outreach

MSE 2110 Intro to MSE II
MSE 4310 Principles of Metal Casting
MEEM 3600 Intro to Manufacturing
MET 3500 Manufacturing Processes
FA 3335 Traditional Sculpture
Advanced Metalworks Enterprise (AME)
Finlandia University Sculpture class
Summer Youth Program (SYP)
- Materials Science and Engineering Exploration
- Engineering Scholars Program (ESP)
- Women in Engineering (WIE)
- Junior Women in Engineering (JWIE)

AMEA Advanced Metalworks Enterprise

FINLANDIA UNIVERSITY · Ford · Summer Youth Programs

Michigan Technological University Materials Science and Engineering
Michigan Technological University School of Technology
Michigan Technological University Pavlis Honors College
Michigan Technological University Mechanical Engineering-Engineering Mechanics
Michigan Technological University Visual and Performing Arts

Entrepreneurship & Creativity

MakerMSE™ provides a path for students to propose, design, and create products for sale, commission, or to simply establish a capability or methodology for future use.

Examples include:
- Retro Michigan Tech bookends (cast)
- Upper peninsula bottle openers (extruded)
- Etched bird-strike-resistant glass (laser etching)
- Departmental / University plaques (cast)
- Name plates (cast)
- Hancock "Hey Bulldog" (segmented casting)