Materials Analysis, Testing, and Fabrication (MATFab) Facility Strategic Plan (2024-2029)

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History and Current Status of the MATFab Facility

The Materials Analysis, Testing, and Fabrication (MATFab) Facility was created in 2018 to consolidate instrumentation and expertise in materials characterization and fabrication on the University of Iowa campus. This unit serves a critical research mission on the University of Iowa campus as it focuses on chemical[1] and physical characterization of hard materials[2] and fabrication of films, surfaces, and devices with micro- and nano-resolution[3]. It serves faculty research needs in the University of Iowa Carver College of Medicine, College of Dentistry, College of Engineering, College of Liberal Arts and Sciences, College of Pharmacy, and College of Public Health. In addition, it provides access to these resources to researchers at local, state, and regional universities, colleges, and industrial partners.

This effort was led by the Office of the Vice President of Research and brought instrumentation from department, colleges, and core facilities into the Iowa Advanced Technology Laboratory (IATL 170, 172, 174, and 198). The facility expanded into IATL 196 in 2023 as additional equipment was added to the core from departmental and collegiate units on campus. Two of the laboratories house materials characterization instruments and a third contains wet bench and hood space for sample preparation. Characterization instrumentation currently include electron microprobe, two scanning electron microscopes (SEM), high-resolution inductively coupled plasma mass spectrometry (HR-ICP-MS),inductively coupled plasma mass spectrometry (ICP-MS) inductively coupled plasma optical emission spectroscopy (ICP-OES), Raman spectroscopy paired with an optical microscope, combustion elemental analyzer, Brunauer-Emmitt-Teller (BET) analysis, thermogravimetric analyzers (TGA), Micro computed tomography (CT), spectroscopic ellipsometer, 3-D profiling, X-ray fluorescence spectroscopy, and three X-ray diffractometers. Sample preparation capabilities include a microbalance, fume hoods for acid dissolution, and a microwave digestion system. Our fabrication facility is housed in 1500 ft^2 of clean room space and has deposition and etching tools for building small structures at the micro and nanoscale, with applications in LEDs, semiconductors, and microfluidics. Fabrication equipment includes electron beam nanolithography system, nanoimprint system, mask aligner, e-beam evaporator, sputterer, and plasma etching equipment. The facility is currently staffed by three full-time staff members and additional part-time support personnel who oversee instrument operation, routine maintenance, user training, and consult on data analysis.

MATFab Mission, Vision, and Values Statements

Mission: Our mission is to empower innovation and discovery in science and engineering by providing advanced fabrication and characterization of natural and engineered materials.

Vision: To be a premier facility for materials fabrication and characterization in the Midwest by offering state-of-the-art capabilities, technical expertise, and educational opportunities.

Values: Provide high quality data, technical support, and training for our users in a timely and professional fashion.

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[1] Our expertise is in elemental, structural and spectroscopic chemical analysis; molecular speciation is the focus of the HRMS facility (https://hrmsf.research.uiowa.edu/) and other collegiate and university resources.
[2] MATFab focuses is on the characterization and fabrication of hard materials; soft biological materials is the focus of CMRF (https://cmrf.research.uiowa.edu/) and other collegiate and university resources.
[3] Our fabrication capabilities are unique from Protostudios (https://protostudios.uiowa.edu/) due to the focus on micro and nanoscale design.

The MATFab facility is pivotal for advancing research and education in the field of materials science. By providing state-of-the-art equipment and specialized expertise on the University of Iowa campus, the MATFab facility enables students, researchers, and faculty to conduct cutting-edge experiments and analyses that push the boundaries of their respective fields. This capability not only accelerates the pace of discovery but also strengthens research and instrumentation grant applications and attracts funding from external sources, as research proposals are bolstered by the availability of sophisticated instrumentation and technical support. In addition, the facility has also extended the lifetime and capabilities of instruments currently on campus as it has acquired instruments from other units that were purchased using federal and private funds but did not have the resources for maintenance and technical support. It also serves as a hub for interdisciplinary collaboration, fostering innovation, and allowing for the exploration of new materials with applications ranging from electronics to biomedicine. By supporting both fundamental and applied research that occurs within the MATFab facility, the University of Iowa enhances research capabilities, attracts significant external funding, and enhances the number of high-profile publications and patents. Overall, the presence of the MATFab Facility on the University of Iowa campus enhances faculty and student productivity, amplifies their research impact, and contributes to their professional growth and recognition within the academic community.

Overview of Strategic Planning Process

The MATFab staff and director began developing a strategic plan in Spring 2024. The MATFab mission, vision, and values statements were reviewed to ensure that they still represented the facility. An environmental scan that included a SWOT (strengths, weaknesses, opportunities, and threats) analysis and targeted interviews with users was performed to gain additional insights into the future directions of the facility. From this information, the director and staff identified the core impacts that MATFab will foster in the next five years. That outcome led to the development of strategic goals and metrics of success. Goals are separated into four categories: (1) Instrument focused; (2) User focused; (3) Internal Processes; and (4) Growth and Development. These categories and related goals were also discussed within the context of the University of Iowa Strategic Plan to evaluate alignment. The staff and director then identified resources needed to meet goals, milestones, and team leads for each goal. The draft strategic plan was completed in May 2024 and evaluated by the MATFab Faculty Advisory Board. Feedback from this group was included into the second draft of the strategic plan and it was circulated to the users and the OVPR administration for additional feedback. The final document was approved on September 7, 2024. Progress on goals and milestones will be evaluated annually and updates will be reported to the users and administration.

SWOT Analysis for UI MATFab facility

The SWOT analysis was completed by the MATFab staff and director with additional feedback from targeted users. The top five in each category are listed in the section below.

Strengths (Internal):	Weaknesses (Internal):
• Technical and mechanical expertise with current staff • Development of policies for equity and communication practices to current users • Improvements in laboratory management and accessibility • Expanding variety of instruments for diverse research needs. • Expanding connections to university-wide and external researchers and industrial partners	• Derelict clean room space • Aging equipment • Communication to potential users • Need more characterization tools for porous and environmental testing materials • Complexity in billing due to diversity in instruments
Opportunities (External):	**Threats (External):**
• Instrumentation grants and workforce development opportunities through federal, state, and private entities • Collaborations with regional core facility partners • UI faculty to develop more instrumentation resources and methodology • Reach more external users through remote access opportunities (Team Viewer), web resources, and highlighting scholarly work. • Hiring of new faculty in the area of environmental sciences and fabrication	• IATL Issues (flooding, fires, cubicle style office space, terrible conference room, rennovations) and lack of facilities management • Retirements and lack of collaboration in hiring and retention of faculty that can utilize the equipment. • No university resources for aging Infrastructure • Lack of promotion and professional development opportunities for staff could lead to departures. • Lack of engagement from faculty and college for workforce development and student training

MATFab Impact Goals

In the next five years, the MATFab Facility seeks to have the following impacts:

- Clear record of impact on University of Iowa faculty research activities within the scientific communities and across federal agencies
- Improved communication of research activities and capabilities across the entire University of Iowa campus
- Improved engagement with the faculty to collect data, train students, and acquire new instrumentation for the facility.
- Increased footprint and reach to include more departments across the University of Iowa and regional institutions.
- Improved opportunities for professional development and engagements in departments/colleges for University of Iowa staff and students.
- Continued leadership to improve core facility management on the University of Iowa campus.

MATFab strategic goals and metrics of success

Growth and Development Goals

Goal 1: Shoring up fabrication capabilities to meet the needs of the users.

Strategies	Metrics of success
Interface with users to understand the main tools needs and how they are used in the process	Meet yearly with fabrication user group; Meet with each group individually at least once in the five year plan.
Submit proposals to federal agencies and private foundations for acquisition of new equipment	At least one proposal per year supported for new instrumentation, upgrades, and staff time until all fabrication tools are upgraded to working condition
Redesign laboratory layout/structure to meet the needs of the instruments and users with best practices	Improved workflow in IATL 172 and 174
Determine strategies to improve wet bench processing	Create management plan and operating scope of activities for wet processing in the facility and defined waste procedures for wet benches

Goal 2: Develop a marketing strategy for the MATFab facility

Strategies	Metrics of success
Work with OVPR to create marketing material for MATFab facility	Marketing plan developed for external and internal customers
Develop LinkedIn profile for MATFab facility for the purpose of corporate and external marketing	LinkedIn profile that includes updated virtual content
Improve website to include videos and interactive media	Videos and media on the MATFab website
Work with OVPR to utilize digital signage across campus	MATFab advertisement on digital signage associated with STEM departments and buildings

Goal 3: Create metrics and ways to show value of our facility to the UI research enterprise

Strategies	Metrics of success
Identified number of grants that are impacted by MATFab	A firm annual number for "dollars touched" for the facility
Work with OVPR to create compelling graphics for number of users and connection to colleges	Graphics that show dollars touched, connections to research, impacts of internships
Connect with users to highlight cutting edge research done in the facility through MATFab website and UI media	Two researchers highlighted annually on the MATFab website
Evaluate publications that are impacted by MATFab instrumentation and staff	Annual tally of publications that are impacted by MATFab
Create annual report to distribute to administration	Three page annual report delivered every summer to users and administrators

Goal 4: Create opportunities for undergraduate and graduate students to learn laboratory management and tool maintenance/development

Strategies	Metrics of success
Interface with office of undergraduate research to evaluate possibilities of undergraduate intern program with facility and shops	Double the number of undergraduate interns that we can support in the program (Increase from 1 or 2 to 4)
Evaluate funding opportunities for interns with local industrial partners	Identify possible industrial partners that may be interested in training and contact them about possible connections to training in facility
Create strategy to find undergraduate internship opportunities	Evaluate partners for undergraduate internships opportunities at local, university, and state levels and develop funding opportunities for student workers

User focused Goals

Goal 1: Develop a more engaged scientific community for the users

Strategies	Metrics of success
Create a MATFab research event (poster session, speakers)	YR 1: Pilot annual event and assess success; YR 2-5: continue growth with 20% attendance by the users
Create a wiki site to share resources and ideas	Creation of the wiki site and monthly engagement on the site by the users
Create webinar series for companies to help with training and scientific knowledge	YR 1: Pilot webinar and assess success; YR 2-5: continue growth with 20 % attendance by the users
Staff attend scientific meetings to engage with larger scientific community and discuss MATFab capabilities	At least one MATFab staff member attend an annual conference every year and present MATFab capabilities
Organize Core Facility Meeting to further develop UI connections and resources	Host the NNLA meeting at the University of Iowa

Goal 2: Improve website for facility/instrument use and sample preparation

Strategies	Metrics of success
Develop webform for sample submission	MATFab users utilizing the only webform to submit samples
Create a tool status update process that is accessible online or provides alerts to users	Daily updates on tool status that is available for the MATFab users
Update fabrication details on the website to improve information	Images and text available on the website that describes all fabrication tools
Create training videos for chemical safety	Users accessing training videos for chemical safety in the facility
Increase information for instrumentation to provide more fundamental and technical details for ease of use	Resources regarding technical details of each instrumental available on the website
Develop flow chart for helping people find the best technique in the MATFab facility for their scientific question	Development of flow chart capability on the MATFab website.

Goal 3: Intersect with regional partners to increase access to instrumentation and capabilities

Strategies	Metrics of success
Work with Iowa State University to create partnerships and reduce barriers to utilize equipment	15% increase in number of users from ISU in MATFab and use of ISU XPS and SAXS equipment by Iowa users
Develop strategy with NNLA to create more accessibility to fabrication equipment in the Midwest	Attend annual NNLA meeting, dialogue with staff at partner institution, and increase Iowa usage at partner institutions
Outreach to small colleges and regional institution in region to improve connections to MATFab facility	Present two talks annual at small colleges and regional institutions regarding MATFab capabilities

Instrument focused Goals	
Goal 1: Increasing the user base by improving sample preparation on high value instrumentation	
Strategies	Metrics of success
Create infrastructure to handle sample digestion for ICP analysis	Fume hood space and capabilities for acid and microwave digestion owned by MATFab.
Develop capabilities to press pellets and create samples for XRF analysis	Dedicated pellet press and furnace for XRF available for users and methodology for powders
Develop HF capabilities for use on campus to improve user safety and work with EH&S to advertise on campus	Video resources, training, and space to work with HF safety on campus.
Goal 2: Develop and distribute standard operating procedures for instrumentation	
Strategies	Metrics of success
Categorizing the type of SOP (signage, word document, and videos) needed for each piece of equipment	SOP type identified for each piece of equipment in an excel document
Categorizing how the SOPs will be distributed to the users (laminated document in lab, on website/Bookit/Youtube, on sharepoint)	SOPs distribution identified and categorized in an excel document
Develop in-lab signage for selected instrumentation and post in the relevant labs	Signage posted for selected instruments that users utilize for instrument use.
Create written SOP documents for selected instrumentation and distribute to users	Documents available for selected instruments
Create video SOPs and post on selected distribution system	Videos available selected instrumentation for additional training and use; identify number of users watching videos
Integrate SOP into training	Users will sign training document to ensure that they have been notified.
Goal 3: Improve billing and revenue for instrument time	
Strategies	Metrics of success
Ensure all instruments are connected to Bookit through computers or relay systems	All instruments and MATFab capabilities billing automatically through Bookit with minimal input from staff
Evaluate capabilities and billing rates, compare to peer institutions, and adjust accordingly	Policy related to billing adjustments, document assessing capabilities and rates compared to peer institutions, increased fees on instrumentation as needed
Develop a marketing plan for JEOL electron microprobe, Rigatku XRF, and Raith lithography system to find new users	25% increase in usage for instrumentation

Internal Process Goals

Goal 1: Develop a policy to evaluate instrument charges, lifetime, and replacement

Strategies	Metrics of success
Work with OVPR accounting to develop methodology to evaluate instrument charges based upon subvention costs, instrument costs, and peer institution rates	Updated instrument charges that optimize recharge without impacting usage
Determine metrics to evaluate lifetime of an instrument (availability of parts, constant maintenance, ability to service, user base) - Instrument Health Assessment	Metrics established to determine instrument lifetime for use in informed decision making
Develop metrics to evaluate when instruments should be replaced or sunset	Metrics established to determine instrument replacement vs. removal from facility
Create policy documents for changing charge structure and instrument lifetime and replacement	Policy developed for charge structure and instrument lifetime and replacement

Goal 2: Develop strategy for internal inventory (parts, tools)

Strategies	Metrics of success
Evaluate platform and details needed for an internal inventory	Establish method to create internal inventory of parts, tools, and equipment
Determine current inventory of MATFab for parts and tools	Current inventory for parts and tools available on MS Teams
Develop plan to keep inventory current	Policy for annual inventory for MATFab parts and tools

Goal 3: Better processing to onboard/tasks undergraduate student interns

Strategies	Metrics of success
Assess current needs for onboarding undergraduate student interns	Develop understanding of onboarding needs
Develop onboarding and mentoring strategies for undergraduate student interns	Create form for onboarding and document for mentoring plan
Create online platform for delegating tasks and ensuring completion	Online platform for delegating tasks and completion that is utilized by the staff daily or weekly
Develop assessment tools to help with managing and reviewing undergraduate student internship performance	Development of annual evaluation form for undergraduate internship

Alignment of the MATFab Strategic Plan with the University of Iowa Strategic Plan

The MATFab strategic plan is designed to align seamlessly with the University of Iowa's overarching strategic plan, ensuring that the goals and initiatives contribute to the broader organizational objectives (https://strategicplan.uiowa.edu/strategic-plan-2022-2027). Our efforts on enhancing material science resources and expertise directly align with the University's priority of innovative research and creative discovery. Within this priority area, our efforts directly align with the identified objectives and strategies.

By aligning unit priorities with the University of Iowa's vision, mission, and strategic goals, the unit ensures that its efforts are directly supporting the University's long-term success. This alignment is achieved through a clear understanding of the University's strategic imperatives, such as research innovation and workforce development, and by setting specific targets that drive progress toward these objectives. Regular communication and coordination between the MATFab facility and OVPR leadership further ensure that the strategies remain in sync with evolving University of Iowa's goals, enabling agile responses to shifts in the research environment and optimizing resource allocation. Ultimately, this alignment fosters a cohesive approach to achieving the University of Iowa's vision, enhancing overall performance and competitive advantage.