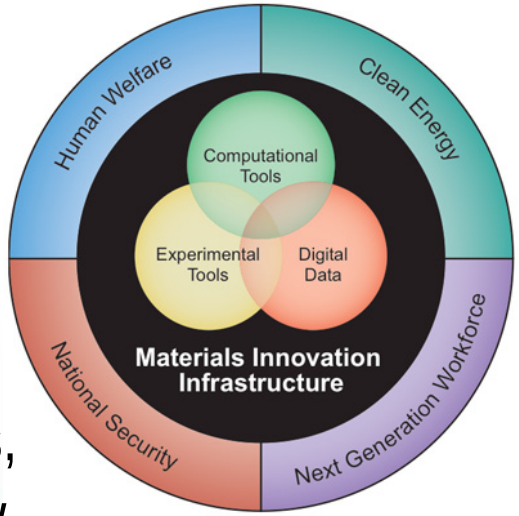
Materials Innovation Platforms (MIP)

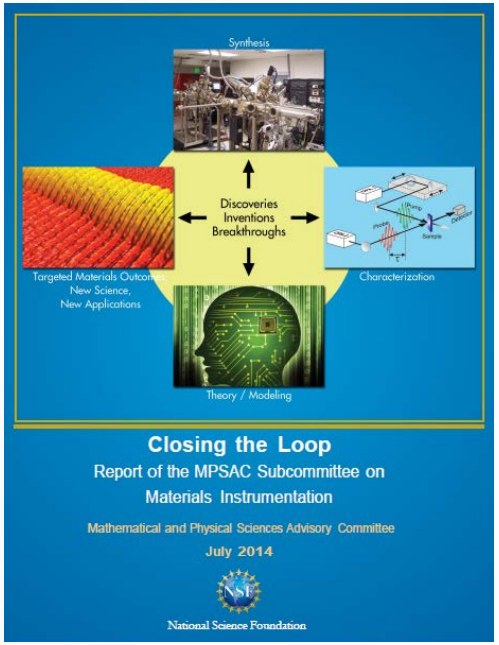
Charles Ying, G. X. Tessema, and Leonard Spinu
Program Directors
Email: mip@nsf.gov

Webinar for MIP Solicitation *NSF 19-526*
1:30 – 2:45 pm EST, December 18, 2018

Materials Innovation Platforms (MIP)

- A mid-scale infrastructure program in DMR
- Build and nurture a scientific ecosystem, using the MGI approach and sharing knowledge (instruments, codes, samples, data, metadata, know-how, ...)
- Designed to accelerate advances in materials research topics of national importance





NSF's 10 Big Ideas

- Align with the core of the MIP program
- Possible match for specific MIP proposals

4 Pillars of MIP Convergence

1. Use an integrated approach to meet the critical needs for research, education/training, and research infrastructure
2. Foster a culture of knowledge sharing among in-house research scientists, external users, and other contributors
3. Enable iterative, closed-loop efforts across materials synthesis/processing, materials characterization, and theory/modeling/simulation
4. Empower the merging of ideas, approaches and technologies from widely diverse fields of knowledge (domain science fields relevant to MIP, data science, informatics, ...)

What Does a MIP Do?

- Develop next-generation experimental and computational tools, as well as advancing the capabilities of the current state-of-the-art tools
- Conduct in-house research by a transdisciplinary team in a focused topic designed to address a grand challenge of fundamental science and meet a national need
- Operate a user facility that provides unique materials research tools, samples, data, and technical services open to a diverse community of external researchers and institutions
- Serve as an educational focal point for training the next generation of tool developers and users

The First MIP Competition

- When: 2015
- Topic: bulk and thin-film crystalline hard materials
- Statistics:
  - 42 proposals reviewed
  - 4 finalists invited to reverse site visits
  - 2 awards made in March 2016
    - ✓ 2DCC
    - ✓ PARADIM

2D Crystal Consortium
NSF Materials Innovation Platform

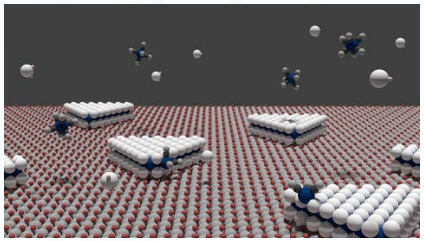
PARADIM
AN NSF MATERIALS INNOVATION PLATFORM

2D Crystal Consortium
NSF Materials Innovation Platform

PennState

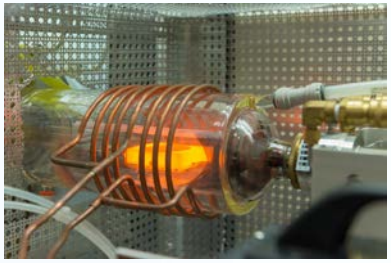
www.mip.psu.edu

Focus: 2-dimensional chalcogenide materials for future electronics



Major User Facilities (all at Penn State University):

- Thin-film growth: CVD, MBE with ARPES, STM & SEM in HIVE
- Bulk crystal growth: Vertical Bridgman & chemical vapor transport
- Theory and simulation: growth kinetics, characterization, etc.



Major Activities:

- Accept user proposals year round – no user fee
- Sample request option – Many delivered
- Annual *Graphene and Beyond* workshops
- Webinars (all recorded and available online)
- Data: Lifetime Sample Tracking (LiST) and STEPFORWARD

NSF DMR DIVISION OF MATERIALS RESEARCH
DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES

PARADIM
AN NSF MATERIALS INNOVATION PLATFORM

www.paradim.org

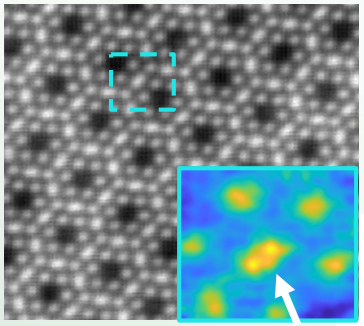
Focus: interfacial quantum materials – combining oxides & 2D materials. To empower practitioners to accelerate the discovery of atomically engineered inorganic materials that revolutionize electronics

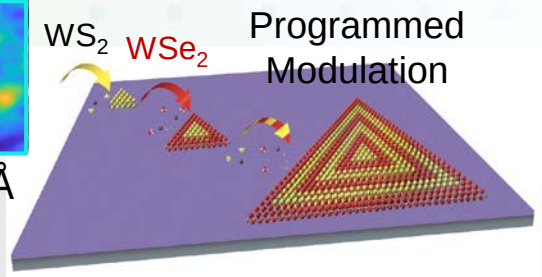
Major User Facilities (at Cornell University unless otherwise noted):

- Thin-film growth: MBE (62 elements) with ARPES, stand-alone CVD
- Transmission Electron Microscopy: record resolution w. an EMPAD detector
- Bulk crystal growth: world's first 300-atm floating-zone furnace (FZF), titled laser-diode FZF, and other FZFs (at Johns Hopkins University)
- Theory and Simulation: electronic properties (at Clark Atlanta University)

Major Activities:

- Accept user proposals year round – no user fee
- Summer schools (all recorded & available online)
- PARADIM Data Collective
- REU



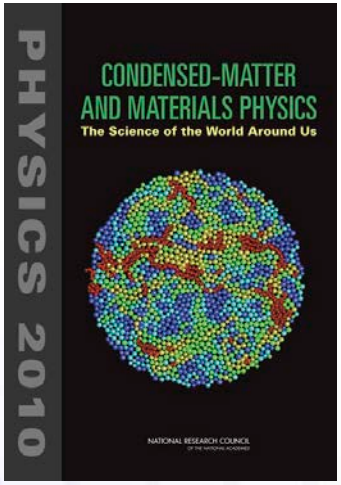


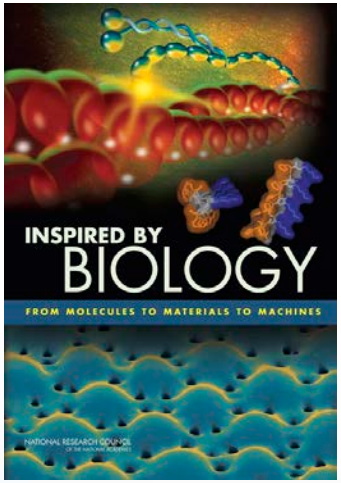
DMR DIVISION OF MATERIALS RESEARCH
DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES

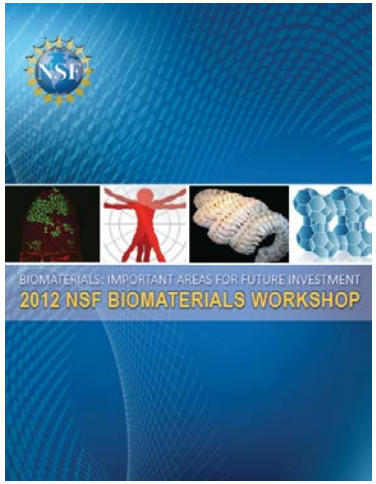
The Second MIP Competition

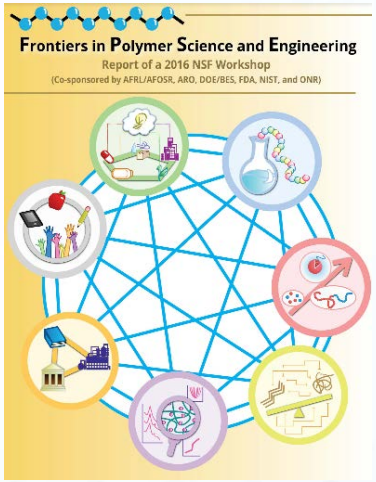
- Topic: the convergence of materials research with biological sciences for developing new materials
- Anticipated awards
  - 1 - 3 awards
  - $15M - $25M over 5 years with the possibility of one 5-year renewal
- Proposal submission deadline
  - New Deadline: April 26, 2019 ~~February 4, 2019~~
- MIP website: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505133
- Contact email address: mip@nsf.gov

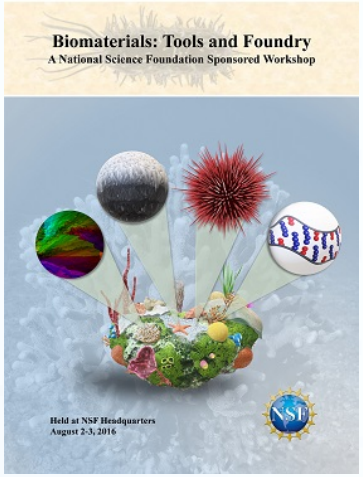
Additional Useful References



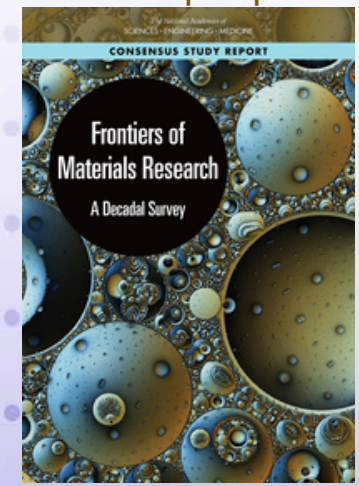








Follow-up report:



The url's of these and other documents can be found at the MIP website, as well as the MIP solicitation.

Review Criteria

- Intellectual Merit
- Broader Impacts
- 7 additional MIP solicitation specific review criteria, each linking to a section or sections in the Project Description of a proposal
  - Vision/Motivation
  - Convergence/Knowledge Sharing
  - Research
  - Infrastructure
  - Facility Operation
  - Education/Training
  - Knowledge Transfer

Additional Review Criterion:
Vision/Motivation

- How well is the proposal motivated by addressing a grand challenge or challenges of fundamental science aligned with national priorities?
  - Consider what a team can do for addressing a scientific grand challenge or challenges, not simply what one can do for career advancement
  - Need innovative ideas at the intersection of different disciplines: Materials research, biological sciences, data science, ...
  - Consider what a team can do that will benefit the whole nation, not just a university or several universities within a region in the US
  - Consider the scientific impacts in the national and international context

Additional Review Criterion:
Convergence/Knowledge Sharing

- To what extent will the proposed MIP substantially accelerate materials discovery and development beyond current approaches, through sharing of knowledge (tools, codes, samples, data and know-how)? How effective will the knowledge sharing mechanisms likely be? Does the MIP have a sound plan to take advantage of opportunities that the emerging data science provides?
  - MIP builds and nurtures a scientific ecosystem.
  - MIP makes full use of opportunities provided by data science such as artificial intelligence and machine learning.
  - MIP goes beyond data management - it shares tools, codes, samples, data (including meta-data) and know-how
  - Different sharing mechanisms could be needed depending on what are shared and with whom (in-house research scientists; users; other contributors)

Additional Review Criterion: Research

- How well is the proposed in-house research focused and targeted to addressing a critical scientific challenge? How well does the proposed research use a tightly closed collaborative loop process with accelerated, iterative feedback among materials synthesis/processing, materials characterization, and theory/modeling/simulation?
  - The scope of MIP's in-house research needs to be more focused than the overall MIP research scope.
  - The in-house research is synergistic to the user program.
  - The in-house research is required to use the Materials Genome Initiative (MGI) approach and needs expertise of materials synthesis/processing, characterization, and theory/modeling/simulation.

Additional Review Criterion: Infrastructure

- To what extent does the proposed MIP meet a critical infrastructure need for the materials community? What is the degree of uniqueness of the proposed key instruments for materials synthesis/ processing and materials characterization in the national context? Do the proposed instruments enable new ways of synthesis/processing of complex materials? Are the plans and timelines for equipment acquisition, development, and commissioning well thought out?
  - MIP's infrastructure is to meet critical research meets in the US.
  - Tools for synthesis/processing, characterization, and theory/modeling/simulation
  - Need both unique tools and other tools required for research
  - Need both new tools acquired/developed through a MIP award (no user fee for US academic users) and existing tools on campus (user fee allowed)

Additional Review Criterion:
Facility Operation

- Are the plans for the user facility operation (e.g., access modes, user proposal review and selection process, staffing, instrument time/resource allocation, user training, and safety) well thought out? To what extent does the MIP provide access to a diverse group of users (including those under-represented in science and engineering), and from a broad range of academic institutions in the United States (e.g., R1 and non-R1 institutions, minority serving institutions)?
  - Need expertise and sound plans for various aspects of user facility operation
  - MIP funded instruments:
    - >50% of the instrument operation time is for external users
    - No charge for US academic users
  - Diversity: gender/race/ethnicity of users; range of US academic institutions

Additional Review Criterion:
Education/Training

- To what extent will the proposed platform serve as an educational focal point for training the next generation of instrument developers and users?
  - A small number of well-chosen activities – focusing on users, as well as graduate and undergraduate students, postdoctoral researchers, and others associated with the MIP
    - Training of users
    - Outreach to potential users
    - Education/training of next generation of instrument developers

Additional Review Criterion:
Knowledge Transfer

- To what extent does the proposal include industrial involvement through, for example, sharing instruments, samples and expertise, for commercialization of new instruments and deployment of novel materials?
  - Foster deployment of novel materials
  - Commercialize new tools
  - Towards long-term sustainability of the MIP after 10 years

Eligibility and Limitations

- Proposals to be submitted by Institutions of Higher Education (IHEs)
  - IHE is defined at *NSF Proposal and Award Policies and Procedures Guide*
  - The upcoming version of PAPPG, *NSF 19-1*, is applicable to MIP proposals.
- One MIP proposal per organization as the lead institution
  - Only the single proposal method, submitted by the lead institution with subawards to other institutions if any, should be used.
  - The 2 institutions that were awarded a MIP in the 2015 competition as the lead institution are not eligible to submit a MIP proposal as a lead institution in the 2019 competition.
- Individuals may appear as Senior Personnel only on one MIP proposal
  - Senior Personnel: PI (MIP Director), coPIs (listed on the proposal Cover Sheet) and other faculty or equivalent with biographical sketches included in MIP proposal

Budget

- $15M - $25M over 5 years
- Annual budget should not be evenly distributed over 5 years.
- 3 MIP activities likely having the highest budget:
  - Instrument acquisition and development (mainly in the first few years)
  - User facility operation (may ramp up over time; no less than the in-house research budget after reaching a steady state)
  - In-house research
- Knowledge sharing is critically important even though its budget may be smaller than that for the 3 activities above.

Competition Timeline

- Proposal submission deadline
  - New Deadline: April 26, 2019 ~~February 4, 2019~~
- Invitation of finalists for reverse site visit at NSF
  - August 2019 ~~Around April 1, 2019~~
- Reverse site visit at NSF
  - September 2019 ~~Late April, 2019~~
- Award
  - Early 2020 ~~September 2019~~
- Declination
  - The second half of calendar year 2019

Questions?

- MIP website: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505133
- MIP Program Directors: Charles Ying, G. X. Tessema, Leonard Spinu
- Contact email address: mip@nsf.gov