Materials Innovation Platforms (MIP):

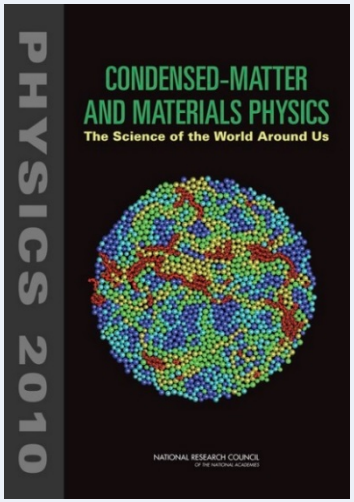
NSF *Mid-scale Instrumentation and User Program to Accelerate The Discovery of New Materials*

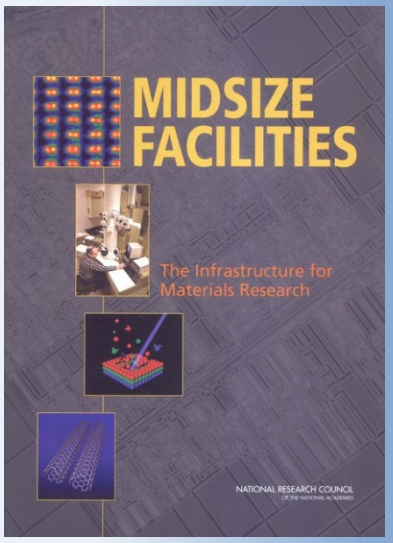
2016 Materials Genome Initiative PI Meeting

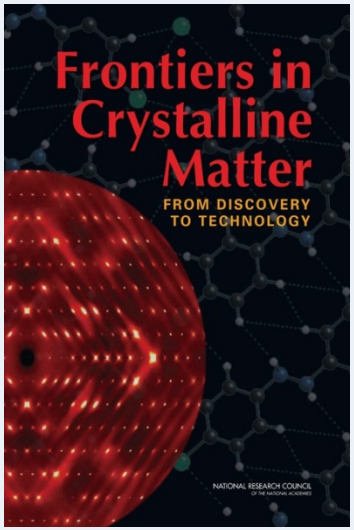
Sean L. Jones, Guebre X. Tessema, and Leonard Spinu
Division of Materials Research
National Facilities program

DMR Mid-scale Facilities

- The need for Mid-scale Facilities has been highlighted in several reports: MidSize Facilities (2006), Frontiers in Crystalline Matter (2009), CMMP Report (2010), DMR COV (2011), and Materials 2022 (2012).
- Most recent reports recommend NSF consider regional facilities to enhance materials-related infrastructure in the U.S.
- Mid-scale user facilities focused on a science topic, not an instrumentation type.
- Include instrument development and cross-disciplinary training of users and students.
- Support for technical staff is key.







Materials Innovation Platforms (MIP)

July 2014: MPS AC Study – *Closing the Loop*
Cherry Murray and George Crabtree, co-Chairs
Graphic courtesy of Charles Anh

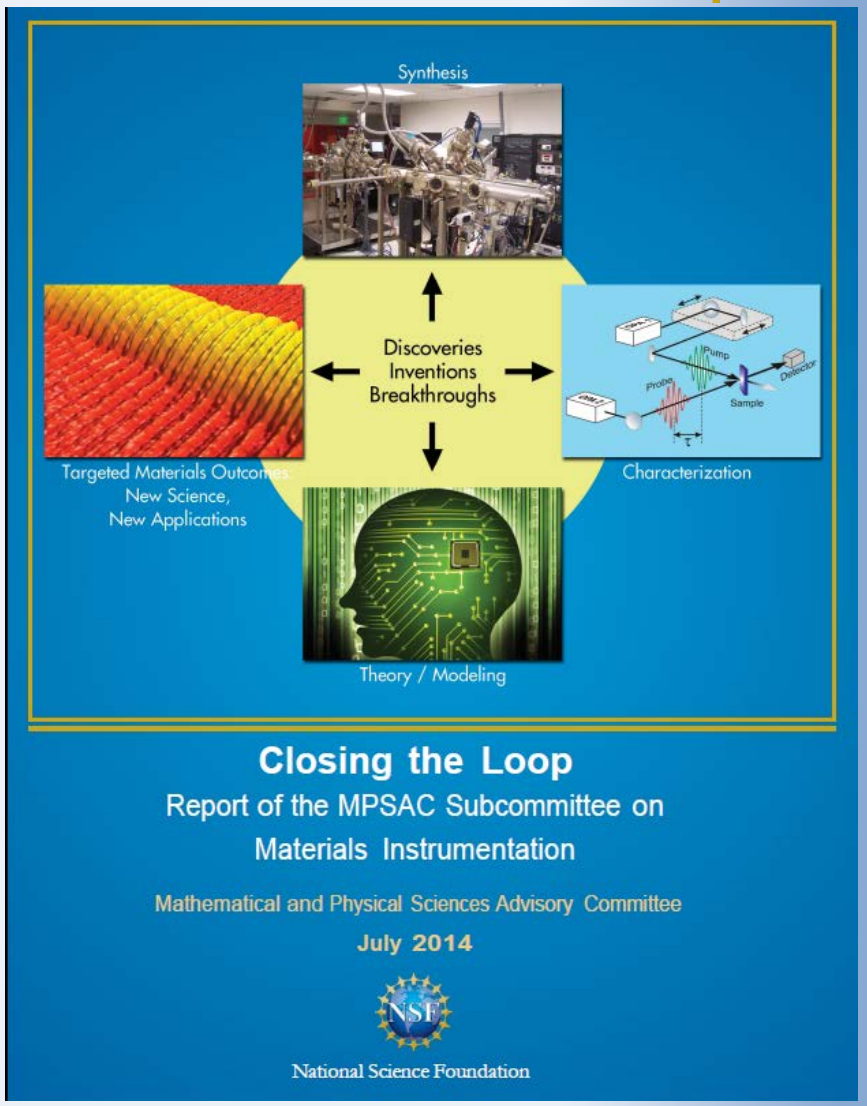
Need *Materials Innovation Platforms* focused on targeted national priorities (**MIP**).

Mid-scale facility focused on a science topic, not an instrumentation type.

With flat budgets, DMR's investments in facilities should be for "unique capabilities".

Adopt MGI/DMREF strategy and combine synthesis, characterization, theory and computation – accelerate materials discovery.

Need national materials synthesis capabilities.



Materials Innovation Platforms (MIP)

New Model for DMR – focused research effort and mid-scale user facility together.

5 Aspects of a Platform:

- Area of National Importance
- Focused Research
- Mid-scale Level Tools - access to external users
- “Community of Practitioners”
- Education and Outreach

…establish focused research teams who substantially accelerate the discovery of new materials and phenomena through the access of unique and world class instrumentation which provide access to users nationwide.

Research: Focused Area

Conducts research in an area of national importance, addressing a bottleneck or missing capability.

Within this priority area, the research topic is focused, targeted, and seeks to advance a specific scientific or technological outcome. *Not seeking multiple research thrusts/themes.*

The chosen area will benefit from an approach involving the iterative and closed-looped collaboration between synthesis, characterization, and theory; and

The problem being addressed is of a scale and significance that requires a mid-scale level investment in equipment and a user facility to engage the external community to further advance the proposed area of research.

MIPs differ from Materials Research Science and Engineering Centers (MRSECS) by conducting research that is very focused and targeted, leading to technological outcomes in an area of national importance and significance.

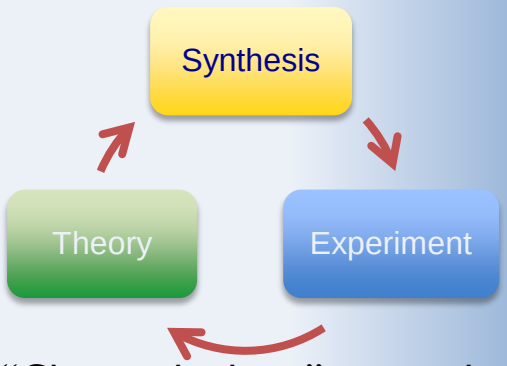
Research: Accelerated Discovery

Research is conducted by clearly defined experts in synthesis, characterization, and theory/computation (S,C,T).

To accelerate materials discoveries, it is expected that each area of expertise guides the other in an iterative closed-loop process.

This team should be of an appropriate size.

Advances in each area – (S,C,T) are expected.



"Closing the loop" must advance or accelerate materials design

What materials design or development problems can I solve with the experimental, theoretical and computational tools at my disposal? What new "tools" do I need to develop?

User Facility

The user facility is a key aspect of a MIP, with instrumentation and capabilities that are unique and enabling making it a national resource.

The facility is of a scale and emphasis that it meets the research interests and needs of a larger community, not just the local group of researchers and their collaborators.

It is open a significant fraction (~50%) of the time to external users who further advance the focused research area at no cost to academic users to utilize the equipment purchased under the MIP award.

Access to all aspects of the MIP are expected – expertise in (S,C,T) as well as the equipment and outputs of the Platform.

The combination of tools/capabilities will be unique that you cannot openly access anywhere else.

User Facility: Access to "Products"

The ability to manufacture and give access to samples is a major consideration of a MIP.

MIPs will have robust data management plans for the curation and access to the samples, data, and codes.

Samples, data, and codes will be *accessible*, even to researchers who may never formally connect with MIP PIs or staff.

Support for individuals and/or resources to make products of the MIP available is allowable in MIP budgets.

The materials community at-large will benefit from the large amounts of samples and data being generated by both the in-house team and the external researchers?

Budget/Instrumentation

Invests in mid-scale equipment > $4M in tools.

Tools (or the suite of tools) acquired or developed are novel and/or unique and go beyond the scope/scale of tools acquired through other NSF modes of support, such as the Major Research Instrumentation (MRI) program.

Substantial support allowed to employ research associates and technicians to manage equipment, interact with users of the facility, and engage in MIP-related research.

Students will be supported, but this is a unique opportunity to allocate budget resources towards research associates, technicians, and equipment.

The budget supports the acquisition and development of unique and enabling tools along with technical resources.

Broader Impacts

The new materials being developed and provided by a MIP should be compelling, rare/hard to obtain, and transformational in nature.

A MIP should train the next generation diverse scientific workforce which is equipped with the scientific and technical depth/breadth to work in a team tackling emerging challenges.

A MIP engages in an appropriate number of impactful and MIP-focused education and outreach activities.

A MIP engages in novel and innovative approaches to transferring the knowledge generated by the in-house research and MIP user community.

The education and outreach activities will amplify the MIP's broader impact on new materials discovery.

MIP Solicitation NSF 15-522

- 5 year award: $10,000,000 – 25,000,000 with a 5 year renewal based on performance.
- 1 to 3 awards, depending on the availability of funds
- 1st competition focuses on the synthesis of bulk/thin film crystalline inorganic materials: 2009 National Academy report - *Frontiers in Crystalline Matter: From Discovery to Technology*.
- Topic subject to change from competition to competition.

Summary

5 Key Elements to a Platform:

- Focused research targeting an area of national importance.
- Team of researchers in the 3 areas of synthesis, characterization, theory/modeling in a closed-loop and iterative collaboration leading to advances in each mode of research.
- User Facility – open access to tools, expertise, data, and new materials.
- Advances in materials discovery are excepted by focused efforts of both in-house researchers and external users.
- Education and Outreach – further advances the mission of the Platform.

Laser Focused effort:

New materials discovery, development, and deployment

Thank you for your attention!

Questions?

sljones@nsf.gov