



Call for Interdisciplinary Research Group Proposals for the Recompetition of the Wisconsin Materials Research Science and Engineering Center (MRSEC)

Date for submission: December 6, 2021

Summary

The Wisconsin Materials Research Science and Engineering Center (MRSEC) seeks proposals for Interdisciplinary Research Groups (IRGs), the central research groups and themes that define the center. Successful IRGs from this UW internal competition will be included in the Center recompetition preproposal to be submitted to NSF in June 2022. An IRG involves ~8 faculty members collaborating over six years to address a grand challenge in materials research. Anticipated funding per IRG is ~\$800,000 per year.

Proposals are due on December 6, 2021. A IRG development and teaming workshop will be held Sept 17, 2021. Interested groups are strongly encouraged to discuss their ideas with MRSEC Director Paul Voyles (paul.voyles@wisc.edu) before submitting.

The Wisconsin MRSEC: Looking Forward to a Recompeted Center

A MRSEC consists of a set of IRGs, efforts in education and outreach, broadening participation in STEM, and facilities, and associated programs like Research Experience for Undergraduate, Research Experience for Teachers, and engagement with industry. The IRGs are reviewed and evaluated individually; the IRGs in the Center do not need an overall theme. The current Wisconsin MRSEC has two IRGs, one on glasses and stability and one on solid phase epitaxy of complex oxides. These IRGs are eligible to recompute, but they do so on an equal footing with all the other proposed IRGs. The recompeted center is likely to contain 2-4 IRGs.

The MRSEC's Education, Outreach, and Diversity efforts are world-leading, reaching millions of people in person and online over the life of the Center. All the participants in the Center, including faculty, postdocs, and students are expected to contribute regularly to education and outreach activities and to efforts to broaden participation. Facilities funding mostly supports instrumentation in the Wisconsin Centers for Nanoscale Technology (wcnt.wisc.edu), but it also includes an effort on data and machine learning in materials research.

The Wisconsin MRSEC is funded through August 31, 2023. Recompetition of the Center will start with the anticipated publication of a new MRSEC call for proposals by NSF in October of 2021, which is followed by the internal IRG competition described in this call. The next step is submission of a preproposal for the new Center to NSF in June 2022. That submission is followed by a full proposal in December 2022 and a reverse site visit presentation in April 2023. A successful recompeted Center begins funding September 1, 2023.

The Center will provide some modest funding for the IRGs selected to participate in the NSF preproposal to generate preliminary results for the full NSF proposal and reverse site visit. That funding will start no earlier than March 2022.

MRSEC Interdisciplinary Research Groups

An IRG is a multidisciplinary, diverse group of ~8 faculty members with total funding of ~\$800,000 per year, supported for six years. IRG funding supports students and postdocs, materials and supplies, facility use charges, and other research-related expenses. IRGs have access to substantial Center-wide resources in addition to the IRG budget for capital equipment, education and outreach, research travel, hosting visitors and workshops, and other similar activities. The MRSEC does not fund faculty salary. IRGs may have 1 or 2 off-campus funded participants,¹ but a large majority of participants must be UW–Madison faculty. Wisconsin MRSEC IRGs have two co-leaders from amongst the 6–8 participants. The co-leaders are also part of the overall Center leadership as members of the MRSEC Executive Committee. Diversity in the co-leaders is

¹ Funded participants must be eligible for NSF funding. Researchers at US national labs or foreign universities, for example, are not eligible for NSF funding. They may participate in an IRG, but they must be funded from other sources.

strongly encouraged.

The MRSEC is evaluated according to the two primary NSF review criteria, intellectual merit and broader impact. Within the Center, the IRGs have primary responsibility for the intellectual merit. An IRG must constitute a nation-leading effort in its area of research and be comprised of a critical mass of faculty who are recognized leaders in their research specialties. An IRG from UW–Madison must be competitive with IRGs in similar areas from other MRSECs around the US. Information about current MRSECs and the IRGs that comprise them may be found at mrsec.org. IRGs contribute to the broader impact of the center primarily through the technological and societal impact of their research. All members of the Center participate in the education, outreach, and broadening participation missions of the center, which are coordinated by the Education and Outreach Group, rather than the IRGs.

In addition to technical excellence, an outstanding IRG must have the following characteristics:

Materials Research: The MRSEC program is entirely funded by the NSF Division of Materials Research (DMR), so an IRG must pursue research in materials science. For NSF purposes, materials science is defined as research that falls within the purview of one or more of the NSF DMR Topical Materials Research Programs (TMRPs), which are Biomaterials, Ceramics, Condensed Matter and Materials Theory, Condensed Matter Physics, Electronic and Photonic Materials, Metals and Metallic Nanostructures, Polymers, and Solid State and Materials Chemistry. Additional information about these programs may be found on the [NSF DMR website](http://www.nsf.gov/div/divim/divimdmr/index.jsp). Every IRG must identify at least one topical area for its research. A strong IRG will identify three or more. *Research that is most strongly identified with or has the greatest impact outside NSF or on programs within NSF but outside DMR is out of scope for the MRSEC program and will not be supported.*

Grand Challenge: An IRG must address a grand challenge in materials science. The scope and importance of the challenge must require a sizeable, interdisciplinary team with substantial resources, working together over a sustained period to address. As a result, the challenge must be much larger than a single-investigator or even short-term small group project. The challenge must be primarily scientific, although development of new technologies and applications is also valuable. Connecting to the NSF Big Ideas or other major initiatives or reports is beneficial but not required.

Interdisciplinary Collaboration: An IRG must contain faculty participants from diverse disciplines. This requires participants from different academic departments and backgrounds who bring different perspectives and skills to the larger group. A strong IRG will contain participants from three or more academic departments. An IRG should comprise a balanced portfolio of materials synthesis, characterization, property measurement, computation, theory, and development of applications. The balance of these components will vary from IRG to IRG, but an IRG completely missing one or more components is unlikely to be competitive.

Interdisciplinarity is connected to the scope of the challenge. An IRG-scale challenge will require collaboration of an interdisciplinary group to address successfully. Interdisciplinary collaboration in an IRG should generate new, creative ideas and research approaches that would be impossible for any single participant or pair of participants. An IRG team must be more than the sum of its parts. One performance metric for the success of an IRG is the fraction of the papers it produces with two, three, or even more IRG faculty co-authors.

Diversity: A key goal of the Wisconsin MRSEC and the MRSEC program overall is encouraging broad participation in materials science at all levels, from K–12 to the professoriate. An IRG must contain diverse participants and contribute to the diversity of the overall Center membership. Important aspects of diversity include gender identity, race and ethnicity, sexual orientation, and faculty rank, in addition to the aspects of academic background and experience that constitute interdisciplinarity. Diversity in leadership roles of the IRG is particularly important.

Additional information about the MRSEC program may be found in the most recent NSF MRSEC solicitation, [NSF 19-517](https://www.nsf.gov/pubs/2019/nsf19-517/nsf19-517.pdf), published in 2019. While the solicitation for the Wisconsin MRSEC recompetition proposal will not be exactly the same as NSF 19-517, it is the best current guidance from NSF. In particular, the “additional strategic research areas” of synthetic biology, structural materials under extreme conditions, and recyclable plastics and materials for sustainable development may evolve in the next solicitation. The solicitation’s

encouragement to broaden the total MRSEC portfolio by including the use of machine learning in materials science is more likely to remain, as is the emphasis on the [NSF's 10 Big Ideas](#).

Proposals

An internal IRG proposal follows the guidelines in NSF 19-517 for the IRG sections of the MRSEC full proposal. It consists of a project description (10 pages, single spaced, 11 pt type, 1" margins), references cited (no page limit), and 2-page, NSF-format biosketches for all of the participants. A budget is not required at the internal proposal stage.

In the project description, describe the grand challenge in materials science. Discuss the IRG's long-term vision and approach, highlight unique capabilities and scientific leadership of the participants, and discuss the intellectual merit of the proposed research. Separate headings must address, in one paragraph each, the intellectual merit and broader impacts of the IRG. Broader impacts can include the technological and societal impacts of the proposed IRG. The project description should conform to NSF 19-517, including

"For each IRG proposed, provide a concise description of the long-term research goals and intellectual focus, and describe the planned research activities in sufficient detail to enable their scientific merit and significance to be assessed. Describe the role and intellectual contribution of each senior participant in the IRG, and briefly outline the resources available or planned to accomplish the research goals (it will be helpful to boldface the name of each senior investigator wherever it occurs). The need for an interactive, interdisciplinary approach involving several investigators, and the means of achieving this, should be clearly established. . . . At the beginning of each IRG section in the proposal, name the MRSEC investigators that will contribute to this IRG; also, estimate the total number of undergraduate students, that of graduate students and of postdoctoral researchers that will participate in the IRG. For each IRG, identify adding after the title the main (and if needed a secondary) TMRP (using their acronyms) that the proposed research is best aligned with."

Proposals will be reviewed by the MRSEC Executive Committee, the Center's External Advisory Board, and selected experts outside of UW–Madison. Some IRG groups may be invited to present their proposal to the MRSEC Executive Committee and/or the MRSEC External Advisory Board (date TBD).

IRG proposals will be evaluated using the NSF merit review criteria of **intellectual merit** and **broader impact**. IRGs will also be evaluated using the MRSEC program-specific review criteria from the 19-517 solicitation:

- (1) Does the IRG describe a well-integrated research program distinguished by intellectual excellence and driven by a clear vision leading to fundamental advances, new discoveries, and/or technological developments that could have national and international significance?
- (2) Are the capabilities of the investigators, technical soundness of the proposed approach, and adequacy of the resources (available or proposed), including instrumentation and facilities appropriate for a center?
- (3) Are the benefits of a multi-investigator, interdisciplinary approach to address a major topic or area normally supported by the Division of Materials Research for each IRG clearly laid out? Does cooperation and interdependence of the investigators within the IRG come across?
- (4) Is the work of a scope and complexity that requires Center support?
- (5) Is the IRG addressing cutting edge science?
- (6) Does the IRG foster increased participation in materials research and education of members of underrepresented groups in science and engineering at all academic levels (faculty, postdoctoral researchers, and students)?

Proposals must be submitted by email as a single PDF file by the end of Monday, December 6, 2021 to Kerri Phillips (kphillips22@wisc.edu). Decisions on which IRGs will participate in the preproposal are expected by March 1, 2022.

More Information and Teaming Workshop

The MRSEC will host a workshop for prospective IRG leads, teams, and faculty interested in participating in an IRG from 9 am to 1 pm, Sept 17, 2021 as part of the Center's annual Breakthrough in Research and Education Workshop. The workshop will describe the structure of the MRSEC program and IRGs using the

current IRGs as examples and provide opportunities for prospective IRG leads to pitch their ideas and potential team members to pitch their skills and interests. To pre-register for the workshop, please fill in the Google form at <https://forms.gle/6n6x7ijFBfU4rEbi8>.

Individuals or groups considering an IRG proposal are *strongly encouraged* to discuss their ideas early with MRSEC Director Paul Voyles (paul.voyles@wisc.edu). Current IRG co-leaders Voyles, Mark Ediger (ediger@chem.wisc.edu), Paul Evans (pgevans@wisc.edu), and J. R. Schmidt (schmidt@chem.wisc.edu) can also provide useful insight and advice. PIs interested in incorporating machine learning into their IRG concept, as encouraged in NSF solicitation 19-517, are encouraged to contact Victor Zavala (zavatejeda@wisc.edu) or Dane Morgan (ddmorgan@wisc.edu) for advice.

Further information about the Wisconsin MRSEC is available at mrsec.wisc.edu.