

SC EPSCoR/IDeA

GEAR Collaborative Research Program (CRP)

SC EPSCoR/IDeA Solicitation Number 11-2017

GEAR CRP Program Objectives

The goal of the GEAR CRP (Collaborative Research Program) is to encourage faculty researchers at the three South Carolina comprehensive research universities (CRUs), Clemson University, the Medical University of South Carolina, and the University of South Carolina; and predominately undergraduate institutions (PUIs) to build collaborative CRU/PUI academic research teams that will compete effectively for research funding. GEAR CRP grants will be awarded to build and enhance the network of scientists in the state that will develop thrust-based research clusters associated with the National Science Foundation (NSF) Research Infrastructure Improvement (RII) Track 1-Award entitled “*Materials Assembly and Design Excellence in South Carolina*” *MADE in SC*.

The vision of the *MADE in SC* initiative is to discover and establish new and sustainable approaches for the design and assembly of hierarchical materials at multiple relevant length scales that service South Carolina’s STEM research, education, and workforce needs and invigorate economic development. The focus of this initiative is to discover and develop new intelligently designed optical and magnetic materials, stimuli-responsive polymeric materials, and interactive biomaterials.

MADE in SC Research Priorities

Proposals must respond to one of the following specific research priorities. Highest preference is for collaborative proposals that integrate modeling and/or simulations with experimental research. The list of activities that can be pursued are presented in the Attachment.

1. **Modeling and Computation Core (MCC).** The goal of the MCC is to develop multiscale models and computational tools synthesizing theories, methods, and infrastructure to provide optimized solutions for the materials system. Supporting goals are the development of advanced multiscale theoretical foundations, fast algorithms to handle high throughput computations, high resolution/fidelity imaging and visualization, and big data analytics including uncertainty quantification.
2. **Research Thrust 1 – Intelligently designed optical and magnetic materials.** The goal of Thrust 1 is to explore the inorganic crystal structure and mesoscale assembly of hybrid inorganic and organic materials to control and tailor their optical and magnetic properties. These designed materials and assemblies will exhibit multi-functional, correlated, collective properties leading to, e.g., materials for enhanced energy transfer for lasing and harvesting applications.
3. **Research Thrust 2 – Stimuli Responsive Polymeric Materials.** The goal of Thrust 2 is to design and develop synthesis strategies for polymers able to respond to external cues

leading to, e.g., materials for efficient water treatment and self-repairing materials for harsh environments.

4. **Research Thrust 3 – Interactive Biomaterials.** The goal of Thrust 3 is to develop a fundamental understanding of the effect of physical and chemical signals on cellular behavior across a range of length scales, leading to the development of interactive biomaterials, e.g., for use in regenerative medicine.

Award Information

Award Type: Grant

Maximum Funding Amount Per Project: \$60,000.00

Project Duration: 12 months

Estimate Number of Awards: Number of awards will be based on quality of proposals received and availability of funding.

Eligibility

- Faculty members from any South Carolina college or university may serve as a Principal Investigators.
- A GEAR CRP team must consist of at least one “mentor” faculty from a CRU, as PI or Co-PI, and one or more “target” faculty from one or more PUIs. **Mentor faculty members** are defined as those with tenure or tenure-track appointments at a CRU who are currently serving as the PI or Co-PIs on a major, peer reviewed and extramurally funded research project or who have served in that capacity within the past two years. **Target faculty members** are those who are in the formative part of their careers, still developing their research programs, and with a strong potential to obtain independent support. In some cases, a senior faculty member may be considered target faculty if the individual is entering a new field of research or is collaborating on a project outside of his/her discipline.
- Proposals that include target faculty from a Historically Black College or University (HBCU) are encouraged.
- Proposals that integrate modeling/simulations and experimental research are strongly encouraged.
- A minimum of two undergraduate students must be identified for participation in the project. Students must be enrolled as a STEM major at the home institution of the target faculty and must have high probability of matriculation into graduate school.
- Graduate student support is encouraged especially for students from underrepresented minority groups.
- The home institution of the PI will serve as the fiscal agent and will establish a sub-award for the institution of the target faculty.

Deadline

Full Proposal – Monday, January 22, 2018

Full Proposal Content

The sections below represent the body of the proposal. Failure to submit the required sections will result in the proposal not being accepted or being returned without review. *Note: Where indicated, the number of pages refers to the maximum number of pages allowed and must not be exceeded.*

1. Cover Page (2 Pages)

Use the Cover Page form in Appendix A.

2. Project Summary (1 Page)

Each proposal must contain an NSF compliant summary of the proposed project not more than one page in length. The Project Summary consists of an overview of the activities that would result if the GEAR CRP were funded and a brief description of long-term plans for sustainability of the team. The Project Summary must also include a statement of objectives and methods to be employed, a statement on the intellectual merit of the proposed activity, and a statement on the broader impacts of the proposed activity.

3. Project Description (7 Pages)

The Project Description should provide a clear statement of the work to be undertaken and must include the best scientific and strategic (long-term) objectives of the proposed work and expected significance, the relationship of this work to the present state of knowledge in the field, and the work plan. The Project Description section should have the following:

a. Objectives of the Proposed Work and Relevance

State the objectives of the proposed work and explain how it relates to *MADE in SC* research priorities outlined in the Program Objectives section.

b. Prior Relevant Research

Describe the proposed research project including significance of research and a review of relevant literature related to the proposed work.

c. General Research Plan

Describe the research framework, hypothesis, research questions, methods and procedures, potential outcomes, etc. Describe the broad design of activities to be undertaken (e.g., experimental methods and procedures). Proposers should address what they want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. The research activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified. These issues apply to both the technical aspects of the proposal and the way in which the project may make broader

contributions. Proposers must clearly identify the accomplishments to be expected at the end of the project. Specific milestones must be carefully stated to aid in proposal evaluation.

4. Mentoring Plan (2 Pages)

Describe the mentoring that will be provided to target faculty supported by the project. Examples of mentoring activities include but not limited to: career counseling; training in preparation of grant proposals, mentoring skill, publications and presentations, guidance on how to effectively collaborate with researchers from diverse backgrounds and disciplinary areas; and training in responsible professional practices.

5. Plans to Leverage GEAR CRP Funding (2 Pages)

Faculty receiving funding support from GEAR CRP are required to use their preliminary data to submit at least one joint or multiple individual research proposals to at least one Federal or private research agency or foundation for a minimum of \$100,000.00 per year within 16 months of the initial award date. Describe the plans to leverage GEAR CRP funding and explicitly address the targets and opportunities for future project funding and sustainability of the effort. Outline a plan for submitting research proposals to national and private funding agencies to attract research grants. The plan must include the names of potential agencies and the programs and dates (if known) that will be targeted.

6. References Cited

Reference information is required. Each reference must include the name of all authors (in same sequence in which they appear in the publication), the article and journal title, book title, volume number, page numbers, and year of publication.

7. Biographical Sketches (2 Pages per person)

A biographical sketch is required for individuals identified as senior personnel and must include senior personnel of collaborating institution. NSF format is required.

- **Professional Preparation** – undergraduate and graduate education and postdoctoral training (including location)
- **Appointments** – A list, in reverse chronological order, of all the individual's academic/professional appointments beginning with the current appointment.
- **Products** – A list of: (i) up to five products most closely related to the proposed project; and (ii) up to five other significant products, where or not related to the proposed project
- **Synergistic Activities** – A list of up to five examples that demonstrate the broader impact of the individual's professional and scholarly activities that focuses on the integration and transfer of knowledge as well as its creation.

For more information on NSF format, visit
https://www.nsf.gov/pubs/policydocs/pappg17_1/pappg_2.jsp#IIC2f

8. Budget

Use the Budget forms in Appendix B.

9. Budget Justification (2 Pages per institution)

The budget justification must be composed of no more than two pages for each institution and must include the following sections:

- Senior Personnel
- Other Personnel
- Fringe Benefits
- Materials and Supplies
- Equipment
- Domestic Travel Support
- Publication Costs
- Other Direct Costs

10. Current and Pending Support

The Principal Investigator and all senior personnel must complete Current and Pending Support document in Appendix C.

11. List of Conflicts

Provide conflicts of interest (COI) for each project participant on Appendix D. Conflicted individuals to be identified for each project participant include:

- PhD Advisor: PhD Advisor of the participant (a direct advisor, not simply a thesis committee member) at any time in the past
- PhD Advisee: PhD advisee of the participant (a direct advisee, not simply where student is on thesis committee) at any time in the past
- Co-author: a co-author of the participant (includes papers under review and in preparation) within the past 48 months
- Co-PI: a co-investigator of the participant (includes proposals under review and in preparation) within the past 48 months
- Postdoc Advisor: Postdoc Advisor of the participant (a direct advisor, not simply a collaborator) within the past 48 months
- Postdoc Advisee: Postdoc Advisee of the participant (a direct advisee, not simply a collaborator) within the past 48 months

- Collaborator: a collaborator other than those listed above within the past 48 months (do not list individuals who have merely shared or received data, software, or other intellectual property)
- Co-editor: a co-editor of the participant during the past 24 months

Budget Information

Funding for the GEAR CRP Program is intended to support salaries and fringe benefits, materials and supplies, domestic travel support, publication costs, tuition supplement, etc.

- The budget requested may not exceed \$60,000.00 per proposal.
- The budget for the target faculty institution must be included as a sub-award to the budget of the submitting institution. Only the budget of the submitting institution may include sub-awards.
- A maximum of one month of summer salary per calendar year per faculty member.
- Indirect costs are not allowed under this solicitation.
- Cost-share is not required but encouraged.
- Awardees should ensure that costs claimed under SC EPSCoR/IDeA Program grants are allowable, allocable, and reasonable.

Submission Instructions

Lead PIs should submit their proposals via the SC EPSCoR/IDeA Proposal Submission Portal at <http://scepscoridea.org/Solicitations/proposals/>

- Lead PIs should complete registration in the Proposal Submission Portal.
- Lead PIs will receive a temporary password and should immediately change this password.
- Lead PI should upload the 11 items listed in the Full Proposal Contents section into the Proposal Submission Portal.
- Lead PIs will receive a confirmation email of proposal submission.

Proposal Review Process

Proposals that meet the eligibility requirements and the guidelines of this solicitation will be evaluated by external reviewers based upon the extent to which they meet specific criteria including but not limited to:

- How important is the proposed research to advancing knowledge and understanding within the research priorities outlined in the GEAR CRP Program Objectives section?
- To what extent does the proposed activity suggest and explore creative and original concepts?
- How well does the proposed activity integrate modeling/simulations with experimental research?
- How well conceived and planned is the proposed activity, including proposed methodology/procedures to achieve the stated research aims?

- Assessment of qualifications of the faculty participants and the integration of their expertise in the research plan.
- Assessment of the likelihood that the collaboration will lead to extramural funding
- How well does the proposed activity advance discovery and understanding while promoting, mentoring, training, teaching, and learning?
- How well does the proposed activity broaden the participation of under-represented groups (e.g., gender, ethnicity, disability, etc.)

Award and Reporting Requirements

- Principal Investigators will receive notice of the GEAR CRP award/declination via email.
- The award will be made to the Lead Principal Investigator's Institution.
- A copy of all submitted proposals resulting from the GEAR CRP must be provided to the SC EPSCoR/IDeA State Office.
- All publications (e.g., research publications, press releases, other publications or documents about the research funded by the SC EPSCoR/IDeA Program) and presentations resulting from the GEAR CRP must include an acknowledgement of SC EPSCoR/IDeA Program support and a disclaimer. *“Research reported in this [publication, press release, presentation] was supported in part by the NSF and SC EPSCoR/IDeA Program under award number (NSF Award # OIA-1655740 and specific SC EPSCoR/IDeA grant number). The views, perspective, and content do not necessarily represent the official views of the SC EPSCoR/IDeA Program nor those of the NSF.”*
- GEAR CRP Teams will be required to present their research findings at the SC EPSCoR/IDeA State Conference. Therefore, travel expenses for the State Conference can be included in the budget.
- SC EPSCoR/IDeA Program reserves the right to conduct site visits during the project period for evaluation and reporting purposes. Awardees are expected to provide required information and documentation to the SC EPSCoR/IDeA Program staff and External Evaluator as needed.
- Reassurance of Responsible Conduct of Research (e.g., CITI Certification) are required for faculty researchers and student researchers to be submitted to SC EPSCoR/IDeA Program State Office.
- Progress reports are due every six months after the start date of the award. A template will be provided to the PIs.
- A final report will be due 60 days after the end of the award.

Contact Information

General inquiries regarding this program should be made to:

April Heyward, MRA
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SC EPSCoR/IDeA

MADE in SC Expected Year 1 and Year 2 Activities, Outcomes, and Outputs

Modeling and Computation Core (MCC)

MCC Goals

- Goal 1 - Develop multiscale theories and materials databank that complement experimental approaches for materials design
- Goal 2 - Develop advanced computational tools and open source computational infrastructure that supports the materials design framework

MCC Expected Activities

- Develop multiscale theoretical and computational models for the thrust areas
- Align modeling and simulation tools with specific needs in the materials thrusts
- Identify organizational structure best-suited for simulation and experimental data, compatible with existing materials database systems
- Develop web-based user interface for uploading and downloading data
- Populate databank, use, and share data with broader materials community
- Identify what quantities, at each scale, should be visualized
- Develop multiscale visualization techniques and tools
- Build an interactive platform combining modeling and simulation, data, and visualization
- Design optimization through data mining, machine learning, and uncertainty quantification techniques
- Develop case studies for each thrust

MCC Expected Outcomes

- Novel and improved multiscale theories and computational tools for materials research
- Comprehensive virtual materials design framework synthesizing the database, modeling, and visualization
- Efficient and effective coupling of modeling and simulation with experimental research being conducted in this project

MCC Expected Outputs

- Papers and proposals, integrating theory/simulation with experimental research and accelerating advanced materials design
- Expandable and searchable database to facilitate materials research consistent with the prevailing data format

Research Thrust 1

Research Thrust 1 Goals

- Goal 1 – New structures with desired magnetic and optical properties prepared via crystal growth
- Goal 2 – Synthesis of uniform building blocks and new methods for building mesoscale assemblies

Research Thrust 1 Expected Activities

- Synthesize and characterize complex iron and new rare earth containing oxides and fluorides and characterize their magnetic and optical properties respectively
- Establish growth conditions that leads to crystals
- Develop techniques and particles with anisotropic surface modifications
- Utilize quantum chemistry based prediction tools to develop candidate chemical structures for particles
- Characterize surface properties of particles as isolated and collective phase
- Characterize magnetic and electrical properties of isolated particles and films
- Utilize quantum chemistry based prediction tools to develop candidate structures with enhanced inter-molecular interactions

Research Thrust 1 Expected Outcomes

- Development of new magnetic and photonic crystalline materials and new methods for building mesoscale assemblies
- Integration of the simulation tools with experimental research to efficiently guide the development of new materials and assemblies

Research Thrust 1 Expected Outputs

- New materials with unique optical or magnetic properties
- Increasing number of papers and proposals integrating theory/simulations and experimental research focusing on novel optical and magnetic materials

Research Thrust 2

Research Thrust 2 Goals

- Goal 1 – Develop new knowledge of how molecular components in materials and their interactions with the environment facilitate stimuli-responsiveness
- Goal 2 – Understand how internal or external stimuli can be used to control new materials functions
- Goal 3 – Develop new chemico-physical features in biomaterials that will lead to stimuli-responsiveness

Research Thrust 2 Expected Activities

- Synthesize mixed brush grafted nanoparticles for interfacial responsiveness
- Develop self-healing block copolymers containing responsive pendant side groups
- Synthesize copolymers with segments that exhibit responsiveness to biological environments
- Develop glucose-based copolymers with self-healing properties
- Synthesize and integrate inorganic nanoparticles with copolymers with self-healing characteristics
- Develop copolymer-based molecular sensors capable of responding to electromagnetic radiation
- Develop and understand the role of catalysts and coordination compounds in stimuli-responsive materials
- Develop experimental methods of measuring stimuli-responsiveness
- Develop variable response time capabilities in stimuli-responsive polymers
- Formulate new polymer synthetic methodologies leading to the development of bio-responsive sensors

Research Thrust 2 Expected Outcomes

- Development of new self-repairing materials and sensors
- Grafted nanoparticles for interfacial responsiveness as well as modeling of effects on sensing/response to environment
- Theoretical models and simulation tools that lead to the development of responsive polymers

Research Thrust 2 Expected Outputs

- New self-repairing materials and sensors
- Number of peer-reviewed publications, seminars, and conference presentations in responsive polymers acknowledging *MADE in SC* increasing every year

Research Thrust 3

Research Thrust 3 Goals

- Goal 1 – Synthesis of representative polymeric biomaterials to support fabrication of customizable materials providing a range of chemical, physical, and morphological properties
- Goal 2 – 3D fabrication of biomaterial platforms featuring integrated micro and nano features for interfacing with cells
- Goal 3 – Determine how the biological functions of cells are influenced by their “materials environment”

Research Thrust 3 Expected Activities

- Purify and surface conjugate virus nanoparticles
- Synthesize polypyrrole/biopolymer composites
- Synthesize metal-containing polymers
- Synthesize polyester-based biocompatible polymers
- Assemble virus and virus-like protein nanoparticles into structures
- Synthesize surface-modified conducting polymer/biomaterial composite films and nanoparticles
- Develop and enhance 3D fabrication capabilities
- Demonstrate surface modification of biopolymer composites through direct coupling of peptides
- Characterize the response of microvascular endothelial cells and dermal fibroblasts to representative biomaterials
- Create a database of cell surface receptors and characteristics
- Create a database of cellular energy economy characteristics at the computational computing center

Research Thrust 3 Expected Outcomes

- Development of new biomaterials that communicate and interact with cells
- Integration of the simulation tools with experimental research to efficiently guide the development of new materials and assemblies

Research Thrust 3 Expected Outputs

- New responsive biomaterials
- Number of peer reviewed publications, seminars, and conference presentations in responsive biomaterials acknowledging *MADE in SC* increasing every year

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