

APPENDIX 4: JOHNS HOPKINS UNIVERSITY/MATERIALS RESEARCH SCIENCE AND ENGINEERING CENTER PROFILE

I. Description

Institution: Johns Hopkins University

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Title: Materials Research Science and Engineering Center

Proposal: 0520491

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II. Research Agenda

Research Focus: The Interdisciplinary Research Group of the JHU MRSEC focuses on the exploration of new materials and new fundamental phenomena in magnetic nanostructures with potentially novel magneto-electronic applications.

MRSEC Description

The JHU MRSEC is a single-IRG MRSEC, centered at Johns Hopkins, with additional co-PIs at Brown University, Carnegie Mellon University, and NIST.

III. Education Activities within the University

Description of activities

- ◆ **REU:** we run a summer REU program for 6-8 students, who do research in MRSEC labs. Students are recruited from across the US.
- ◆ **High School Student Summer Internships:** Each summer, eight students from the greater Baltimore area spend four weeks working with MRSEC researchers. This program is designed to introduce highly motivated high school students to materials research by providing an in-depth research project in the MRSEC setting.
- ◆ **High School Teacher Summer Internships:** Physics and chemistry teachers from Baltimore-Washington area high schools participate in one-week internships each summer. The program provides teacher interns with the opportunity to enhance their scientific knowledge through hands-on workshops, to develop new demonstrations, experiments, and student projects, and to establish contacts for future access to the MRSEC's educational resources.
- ◆ **RET:** This two-summer-long program provides in-depth research experience that culminates in educational modules and demonstrations created by the teachers for their own use and for dissemination over the MRSEC website to other teachers across the country.
- ◆ **Physics Fair:** The MRSEC co-sponsors the JHU annual Physics Fair, whose goal is to generate excitement and fascination in the physical sciences for K-12 students. The program includes more than

100 demonstrations run by 50 undergraduate and graduate students, including many MRSEC graduate students. The program also includes physics challenge tests, a “Physics Bowl” contest, and a “Physics Show” given by a suitably charismatic physics professor.

- ◆ **Materials Science Outreach Workshop:** The MRSEC holds periodic outreach workshops on current themes in materials science and engineering. The events are designed to foster interest in science among middle school students and their families, and to promote careers in science. The program is a mix of lecture-style presentations, and hands-on workshops. The most recent, *Explorations in Nanoscale Science and Engineering*, attracted 299 middle school students and 292 parents from 12 states.

Program staff and expertise

All programs are conducted by MRSEC members. Logistical and recruitment support for some programs is provided by the JHU Center for Talented Youth.

Goals and objectives

(see above)

Target audience (educational levels, number of students at each level, etc.)

(see above)

Current activities

Anticipated outcomes and/or deliverables (see above)

Nano S&E content focus

Programs 1-4 above are built around the nanoscience research in MRSEC laboratories. Program 5 is not specifically nano. Program 6 had broader focus to include nano-bio research and other nanoscience programs at JHU as well as MRSEC research.

IV. Education Activities Outside the University

Description of activities

“Inventors of the Future” Mentoring Program: This new program, beginning this year, seeks to interest and motivate students in inner-city high schools to study science and mathematics by providing resources for independent study and research projects. The program, created in partnership by JHU, CMU, the National Inventors Hall of Fame, and the Washington Academy of Sciences, is funded by NSF’s Urban Systemic Program. Student participants will be drawn from inner-city high schools in Baltimore, Pittsburgh, and Washington, DC. MRSEC faculty and researchers will serve as mentors and consultants to both participating students and teachers.

Program staff and expertise

Goals and objectives

Target audience (grade levels, number of students at each level, school districts, etc.)

Current activities

Anticipated outcomes and/or deliverables (student awareness, teacher professional development, curriculum materials, classroom demonstrations, etc.)

Nano S&E content focus

Nano S & E content consultants

V. Education Outreach Materials

Describe and provide examples of materials, outlines, demonstrations, etc. developed for outreach activities for the K-12 and/or informal audiences

As an example, RET participants have created web-based modules on x-ray diffraction, and molecular dynamics simulations for use in high school classrooms. These are available on the MRSEC website. Our high school teacher internship provides half-day or full-day workshops on areas including: characterization of crystal structures and nanostructures diffraction, e-beam and photolithography, scanning electron microscopy, and electrodeposition of nanomaterials. Versions of many of these activities suitable for classroom use have been developed, and instructions are made available to the participants.

Describe a recent successful education outreach activity

Our most recent Materials Science Outreach Workshop, *Explorations in Nanoscale Science and Engineering*, attracted 299 middle school students and 292 parents from 12 states. It featured two keynote lectures for all participants on “*What is nanoscience?*” and “*Nanomaterials for tissue engineering.*” The students, in groups of 15, each participated in 3 50-minute hands-on workshops ranging from “Magnetic Nanowires in Liquid Crystals,” to “Deposition of Nanoparticle-Based Phosphors.” During the workshops, a separate lecture program was run for the parents on topics including “Magneto-electronics” and “Micro and Nanofluidic Technology.”

VI. Education Outreach Evaluation

Summarize outreach evaluation plan

We conduct exit interviews, follow-up interviews, and surveys of participants. We track the career paths of former high-school student interns.

Summarize outreach evaluation results

Feedback from participants has led to improvements in several programs, for example, the HS Teachers Internships, where we have adjusted the schedule and content to better suit their needs.

VII. Lessons Learned

List 2-3 lessons learned to share with others embarking on a nano education outreach effort.

A key ingredient for success is close contact between participants and the MRSEC members. Wherever possible, try to emphasize one-on-one mentoring in a research environment.

Describe what you might do differently in the future

Arrange so that HS teachers can get Continuing Education credit for participation in MRSEC programs.

