

# CONTACT INFORMATION

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# mrsec

MATERIALS RESEARCH SCIENCE AND ENGINEERING CENTER  
Columbia University Center for Nanostructured Materials



# Material Research and Engin



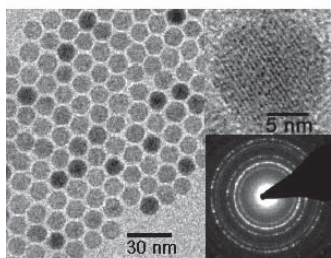
# HISTORY & GOALS

The Center for Nanostructured Materials, the *Materials Research Science and Engineering Center* (MRSEC) at Columbia University, was first established in 1998 with funding from the National Science Foundation (NSF) and renewed in 2002, to engage in interdisciplinary research in nanomaterials, such as nanocrystals. Our Center is also supported by the New York State Office of Science, Technology and Academic Research (NYSTAR).

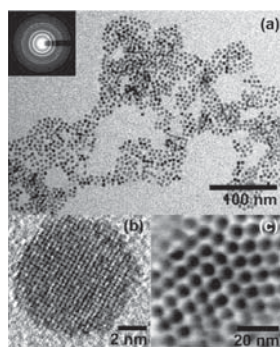
Our MRSEC supports interdisciplinary research, training and education of materials by faculty from six academic departments at Columbia and from the City College of New York (CCNY). It runs a diverse series of programs in education and outreach, and operates a shared facilities laboratory open to Center members and others

The primary research emphasis of our Center is on the materials chemistry of these emerging heterogeneous systems, with an emphasis on the chemistry fundamentals. Our team has the diverse experimental and theoretical expertise needed for success in this interdisciplinary effort, with skills for new nanoparticle synthesis, assembly, and diagnostics.

We are excited that our Center is a focal point of materials research and education in the NY Metropolitan area, with connections to CCNY, IBM Watson Research Center, Brookhaven National Laboratory (BNL), and NYC high schools. Such tight coupling is possible because of the close proximity of Columbia to each of these institutions.



Novel synthesis of iron oxide particles ( $\gamma\text{-Fe}_2\text{O}_3$ ) by colloidal method



Novel synthesis of  $\text{BaTiO}_3$  particles by colloidal method

# OTHER MRSECS

University of Alabama  
Brown University  
University of California at Santa Barbara  
California Institute of Technology  
Carnegie Mellon University  
University of Chicago  
University of Colorado  
Columbia University  
Cornell University  
Harvard University  
Johns Hopkins University  
University of Maryland  
Massachusetts Institute of Technology  
University Massachusetts-Amherst  
University of Minnesota  
University of Nebraska  
Northwestern University  
University of Oklahoma/University of Arkansas  
University of Pennsylvania  
Pennsylvania State University  
Princeton University  
University of Southern Mississippi  
Stanford/IBM-Almaden/UC-Davis  
SUNY Stony Brook - Thermal Spray  
SUNY at Stony Brook - Garcia Polymer  
University of Virginia  
University of Washington  
University of Wisconsin-Madison  
Yale University

For more information on other MRSECS, please visit [www.mrsec.org](http://www.mrsec.org)

## FOR MORE INFORMATION

Contact Information:

Name: \_\_\_\_\_

Email: \_\_\_\_\_

Contact \_\_\_\_\_

Interests in (please check all that apply):

REU \_\_\_\_\_

RET \_\_\_\_\_

High School Visits \_\_\_\_\_

Graduate Research (field: \_\_\_\_\_)

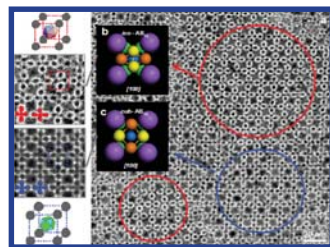
Postdoctoral Research (field: \_\_\_\_\_)

Mail to: MRSEC, Columbia University, 530 W. 120th Street, Room 1001, Schapiro CEPSR, Mail Code 8903, New York, NY 10027



# CENTER COLLABORATION

The MRSEC has established symbiotic collaborative research efforts with industry, national laboratories, and universities, that, given the fundamental nature of our research, offer greater flexibility than traditional industrial affiliates programs. Some of these collaborators include:



Polymorphism in binary superlattices by Dr. Elena Schevchenko, a recent Columbia-IBM bridging postdoc

## National Laboratories

Brookhaven National Laboratory  
Sandia National Laboratories  
Argonne National Laboratory

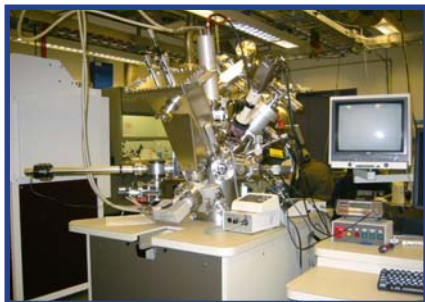
## Industry

Advance Nanotech  
DuPont  
General Electric  
IBM  
Lucent Technologies

## Universities

City College of New York (CCNY)  
Kansas State University  
SUNY Stony Brook  
Tel Aviv University  
Tufts University  
University of Nebraska

# CENTER FACILITIES



XPS/SIMS instrument

The goal of the MRSEC Shared Facilities Laboratory is to house and maintain instruments needed by MRSEC investigators that are normally not found in most PI labs. Facilities include capability for x-ray photoelectron spectroscopy, scanning electron microscopy, atomic force microscopy, ellipsometry, x-ray diffraction,

and FTIR and UV-VIS-IR Spectroscopy. New instruments are chosen that are needed to achieve the MRSEC goals and which most investigators would not normally have in their own labs.

# OUTREACH & EDUCATION

We operate a multi-faceted education and outreach effort, which is focused on the NY metropolitan area. Our activities are highlighted by three themes:

**(1) Summer Research Experiences for Undergraduates and Teachers.** This emphasizes on-campus summer research experiences for undergraduates (REU) and high school teachers (RET), which are described in the next section.



Carla Brathwaite, former RET participant



Adam Brown, High School Visitation volunteer, with students at School of the Future in NYC

**(2) Outreach to New York City School Classrooms through Curriculum Enhancement.** The aim of this component is to impact the classroom experience of students in New York City Schools. The High School Visitation program introduces the interdisciplinary field of materials science and engineering to NYC public high school students through exciting demonstrations. In 2003, we launched the

McNair CITIES Program which helps NYC public high school teachers enhance the New York State Regents curricula by developing exciting classroom demonstrations.

**(3) Collaboration with Museums.** In the Fall of 2005, the Columbia MRSEC and the New York Hall of Science received a grant from the National Science Foundation to launch the Research and Rolling Exhibits (RARE). The rolling exhibits or “discovery carts” will be portable and accessible on a daily basis for visitors to use on the museum floor. A goal of the project is to provide students, teachers and parents with additional opportunities to explore current research in materials science and nanotechnology.



New York Hall of Science explainer describes sand tank



# REU & RET

The Research Experiences for Undergraduates (REU) program allows 10-12 students every summer to be involved in research with MRSEC and other materials faculty. We attempt to match students with faculty according to the student's research interests. Part of the students' hard work has resulted in authorship in published research papers.



2006 REU Participants

In addition, we provide students with the opportunity to visit industrial and government research laboratories in the NYC metropolitan area and attend a weekly seminar series describing the diverse areas in materials science and engineering.



2006 RET Participants

The Research Experiences for Teachers (RET) program allows four NYC public high school teachers to spend two consecutive summers to be involved in research with a MRSEC faculty mentor. The goal of the RET program is to provide New York City middle and high school science teachers with hands-on experience in

scientific research, so they can better understand the practice of science and better convey to their students and fellow teachers a feeling for its practice.

In addition, these teachers receive career development training from the Columbia University Summer Research Program (SRP) for Science Teachers.

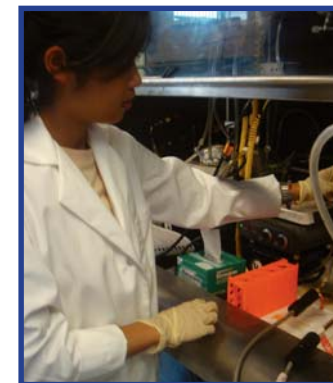
RET alumni have assisted us in evaluating the new education and outreach programs that we have developed to help the MRSEC spread interest in materials and other technology to NYC K-12 schools.



Ann Meyer, RET participant

# RESEARCH

The Center continues to draw heavily on the strengths of the Columbia interdepartmental materials effort in Chemistry, Applied Physics and Applied Mathematics (which includes Materials Science and Engineering (MSE)), Chemical Engineering, Electrical Engineering, Mechanical Engineering, and Physics, along with expertise at other institutions, to bring together scientists with complementary skills to work on the common focus of the Interdisciplinary Research Group (IRG). Our MRSEC team brings together the diverse experimental and theoretical expertise needed for success in such an interdisciplinary effort.



Zhouying Chen, graduate student

Our IRG focuses on novel science in complex metal oxide nanocrystals. The



Alex Nugent, former REU student

common theme in this IRG is synthesis of these oxide particles, controlling their surface ligands, assembling them on surfaces, and understanding the physics of individual nanoparticles and composite films. The total IRG effort is divided into three clusters: 1) Nanocrystal Synthesis and Size Dependent Phase Transitions, 2) Ligand Science and New Materials, and 3) Bimodal Superlattices. Synthetic methods, physical characterization, and theory are integral to each cluster.

