AMBASSADE DE FRANCE AUX ETATS-UNIS
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Chargés de mission

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National Science Foundation
Materials Research Science & Engineering Centers

Résumé :

Financés par la NSF, les Materials Research Science & Engineering Centers (MRSECs) permettent de regrouper au sein d'une université les expertises en Sciences des Matériaux. Favorisant ainsi l'interdisciplinarité, les MRSECs ont aussi la possibilité d'acquérir des équipements, moyens ou gros, en général inaccessibles par les procédés usuels de « proposals » de la NSF. Ces centres d'excellence sont aussi des centres de formation pour la population étudiante, et sont ouverts au milieu industriel pour des collaborations, l'utilisation de ses équipements et la formation des ingénieurs.

Il existe actuellement 29 centres MRSECs implantés dans les universités américaines. Chaque centre possède un ou plusieurs groupes de recherche interdisciplinaire spécifique à un thème d'études. On retrouve, parmi les thèmes de recherche, l'étude des surfaces et interfaces, la structure des matériaux, la science des polymères, les matériaux pour la photonique et l'électronique, la supraconductivité, les matériaux magnétiques, les matériaux biomoléculaires, etc.

Cette note donne une présentation rapide de ces centres, des thèmes de recherche étudiés, des installations expérimentales disponibles, ainsi que les points de contact.

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Introduction au système MRSEC

Financés par la NSF, les Materials Research Science & Engineering Centers (MRSECs) permettent de regrouper au sein d'une université les expertises en Sciences des Matériaux. Favorisant ainsi l'interdisciplinarité, les MRSECs ont aussi la possibilité d'acquérir des équipements, moyens ou gros, en général inaccessibles par les procédés usuels de « proposals » de la NSF. Ces centres d'excellence sont aussi des centres de formation pour la population étudiante, et sont ouverts au milieu industriel pour des collaborations, l'utilisation de ses équipements et la formation des ingénieurs.

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La National Science Foundation (NSF, http://www.nsf.gov/) est une agence gouvernementale américaine assurant la promotion de la Science et la Technologie, à travers des programmes qui gèrent l'investissement de plus de $3.3 milliards par an, avec environ 20 000 projets de recherche et d'enseignement en Science et Technologie dans les universités américaines.

Les contacts à la NSF pour le programme MRSEC sont :

- Dr Ulrich Strom , MRSEC Program Director, Directorate for Mathematical and Physical Sciences, Division of Materials Research (http://www.nsf.gov/mps/divisions/dmr/start.htm) : ustrom@nsf.gov .
- Dr Carmen Huber, MRSEC Program Director, Directorate for Mathematical and Physical Sciences, Division of Materials Research (http://www.nsf.gov/mps/divisions/dmr/start.htm) : chuber@nsf.gov .

MRSEC: Historique

Dans le contexte de la guerre froide au début des années 60, la recherche en matériaux est apparue comme un domaine à développer fortement. Le Department of Defense (DoD), à travers l'ARPA (Advanced Research Project Agency, devenu ensuite DARPA), décide de financer des recherches pour des applications pour l'armement et l'aérospatiale. Des programmes sont lancés par le financement à long terme de sites académiques déjà existants, en prônant une idée maîtresse : l'interdisciplinarité. En 1970, douze IDLs (Interdisciplinary Labs) ont été créés par l'ARPA, qui a dépensé, entre 1961 et 1970, $157.9 millions dans les programmes IDL. Ces centres, qui regroupent les chercheurs de disciplines différentes, sont flexibles et s'adaptent très vite aux nouvelles directions de recherche. Après dix ans d'existence des IDLs, l'ARPA veut recentrer ses programmes sur les applications militaires, et laisser le financement de la recherche fondamentale au secteur civil. En 1972, la responsabilité de ces laboratoires est reprise par la National Science Foundation, qui les rebaptise Materials Research Laboratories (MRL). Le critère d'interdisciplinarité est renforcé, et la NSF tente de réduire le déséquilibre entre la science et la technologie des matériaux.

En 1994, le système est jugé par la communauté scientifique comme élitiste et obsolète : les douze centres MRL ne sont pas forcément les meilleurs centres d'excellence en Science des Matériaux et de nombreuses candidatures à l'imprimatur NSF se font jour dans les universités américaines. La NSF abandonne donc les MRLs pour les MRSECs après appels d'offre et évaluation par les pairs. Les MRSECs sont maintenant financés sur une période finie de 4 à 6 ans. A échéance la candidature doit être réévaluée. Ceci permet une actualisation fréquente des recherches, et la possibilité de créer de nouveaux centres, travaillant sur un sujet spécifique. Au contraire des MRLs, qui étaient assez libres de choisir et réorienter leurs recherches, les MRLs sont créés pour travailler sur un sujet précis pour une durée précise. Globalement le nombre de MRSECs est croissant et atteint aujourd'hui le nombre de 29 centres.

Material Research Science & Engineering Centers (MRSEC, http://www.mrsec.org/)

Ces centres MRSEC doivent posséder de remarquables qualités, compétences intellectuelles, interdisciplinarité, et flexibilité de recherche pour répondre aux opportunités de nouvelles recherches, ainsi que des infrastructures conséquentes, et une intégration complète dans les programmes de formation générale pour les établissements impliqués. Ils doivent se focaliser sur des problèmes fondamentaux et complexes d'importance intellectuelle et stratégique. De plus, ils contribuent aux priorités nationales en favorisant une collaboration active entre les universités et les autres centres de recherche gouvernementaux et industriels.

Le Materials Research & Technology Enabling Cluster de la Division of Materials Research (DMR, http://www.nsf.gov/mps/divisions/dmr/), qui fait partie du Directorate for Mathematical & Physical Sciences (MPS, http://www.nsf.gov/mps/start.htm), gère ces centres MRSECs.

Les projets majeurs de recherche s'inscrivent dans les thèmes suivants:

- Surfaces : dynamiques, réactions, catalyses (*Surfaces : dynamics, reactions, catalysis)*
- Matériaux structuraux / Interfaces / Grain *(Structural Materials/Interfaces/Grain)*
- Interfaces / Nano-mécaniques *(Boundaries/Nanomechanics)*
- Matériaux polymérisés / Science des polymères *(Polymeric Materials/Polymer Science)*
- Matériaux pour l' Electronique et la Photonique *(Electronic/Photonic Materials)*
- Phénomène de Supraconductivité et à Basse Température *(Superconductivity/Low Temperature Phenomena)*
- Matériaux et Structures Magnétiques *(Magnetic Materials and Structures)*
- Nanophase et Matériaux Nanostructurés *(Nanophase and Nanostructured Materials)*
- Systèmes Mésoscopiques *(Mesoscopic Systems)*
- Phases / Transformations de phase / Ordre-Désordre *(Phases/Phase Transformations/Order-Disorder)*
- Matériaux Biomoléculaires et Biomimétiques / Auto-Assemblage / Particules Colloïdales *(Biomolecular and Biomimetric Materials/Self-Assembly/Colloids)*
- Informatique / Modélisation / Théorie des Matériaux Avancés *(Advanced Computation/Modeling/Materials Theory)*
- Synthèse et transformation de conception de matériaux *(Materials Design Synthesis and Processing)*

Il existe actuellement 29 centres MRSECs répartis dans les universités américaines. Chaque centre possède un ou plusieurs groupes de recherche interdisciplinaire (Interdisciplinary Research Groups, IRGs) spécifique à un thème d'études, regroupant plusieurs chercheurs d'origine scientifique différente, afin de contribuer au développement technologique grâce à l'interdisciplinarité. Dans le cadre des MRSECs, la NSF finance aussi des « seeds initiatives » sur des périodes courtes, de un à deux ans, pour des sujets de nature exploratoire. Les universités candidates à ce programme de financement par la NSF doivent obligatoirement faire partie du territoire des Etats-Unis et posséder des programmes larges en recherche et enseignement sur les matériaux. Les MRSECs se doivent d'assurer d'étroites collaborations avec l'industrie pour stimuler le transfert de technologie, avec des projets communs, un accès aux équipements scientifiques, des visites d'industriels, etc. De plus ils doivent promouvoir la science et aider à la vocation scientifique et interdisciplinaire des étudiants. Enfin, chaque université doit aussi assurer l'accès aux équipements scientifiques expérimentaux sous le chapeau du financement MRSECs, pour développer des activités de coopération avec d'autres institutions et d'autres secteurs.

On peut retrouver la liste des subventions dispensées par la NSF pour ce programme MRSEC, depuis 1988 à l'adresse Internet suivante : http://www.fastlane.nsf.gov/servlet/A6QueryBuilder .

On peut aussi trouver des informations sur les événements à venir organisés par les différents MRSECs et sur leurs derniers faits marquants respectivement aux adresses Internet ci-après http://www.mrsec.org/events/ et http://www.mrsec.org/nuggets/.

La NSF entreprend une nouvelle sélection des centres MRSECs pour l'année 2002, et est actuellement en train d'étudier les propositions, après une présélection fin 2001. 10 à 15 projets universitaires seraient récompensés cette année, pour une aide financière totale de $24 millions. Chaque projet élu se verrait attribuer une somme spécifique de $0.8 à $5 millions, pour une période de 4 ans, et 6 ans s'il s'agit d'un nouveau centre MRSEC. Les anciens doivent aussi participer à cette sélection. Dans le cas où ils ne sont pas de nouveau retenus, leur financement sera diminué progressivement sur deux ans et interrompu par la suite. Les résultats devraient prochainement être communiqués par la presse scientifique et/ou le site des MRSECs (http://www.mrsec.org/).

Le guide complet des financements pour la recherche et l'enseignement en sciences, mathématiques, et technologies est disponible sur Internet à l'adresse suivante :
http://www.nsf.gov/od/lpa/news/publicat/nsf0203/nsf0203.pdf . Il s'agit d'une description générale des programmes de la NSF, des domaines de recherche, et des informations sur l'éligibilité concernant les soumissions de propositions spécifiques pour chaque division de la NSF.

Centres MRSECs

Ci-dessous, voici la liste, dans l'ordre alphabétique, de tous les centres MRSEC avec un bref descriptif de leurs recherches :
(http://www.mrsec.org/centers/ et http://www.nsf.gov/mps/divisions/dmr/about/c_current_res.htm)

University of Alabama - Center for Materials for Information Technology

(http://bama.ua.edu/%7Emint/; Director: John A. Barnard)

The research of this MRSEC focuses on magnetic thin film and magnetic nanoparticle materials for ultra-high density information storage. The MRSEC is an integral part of MINT, the Center for Materials for Information Technology, a multidisciplinary research and education center in Tuscaloosa that serves as a resource and communication channel for the information storage industry.

IRG 1: Thin Film Materials for ultra-high density data storage (Leader: John Barnard)
Epitaxial and nanocrystalline FeTaN, GMR spin valve materials, nanotribology

IRG 2: Particulate materials for ultra-high density data storage (Leader: David Nikles)
Dispersion of particles, computer simulations

SEED Project: Molecular Imaging by STM (Silas C.Blackstock and Greg Szulczewski)
imaging on organic thin films by scanning tunneling microscopy (STM). Development of an imaging medium and mechanism that will allow molecular-level information storage.

Arizona State University - Center for High Pressure Materials

(http://mrsec.la.asu.edu/; Director: Otto Sankey)

Research addresses synthesis and characterization of new materials in bulk and thin film form and has a strong pre-college outreach program including use of a science learning van.

IRG 1: High pressure materials research (Leader: G. H. Wolf)
High pressure synthesis of nitrides and related materials, in situ characterization under extreme conditions of pressure and temperature

IRG 2: Epitaxial Nitride Thin Films (Leader: I.S.T. Tsong)
Nitride films grown by MOCVD, analysis using LEEM and high resolution TEM

IRG 3 Nanoscale Silicides (P. Bennett) Investigation of nanoscale epitaxial silicides with the goals of constructing low resistivity interconnects with nanometer dimensions and prototype single-electron devices (SEDs) based on Coulomb blockade.

IRG 4 Conducting Atomic Force Microscopy of Single Molecule Electronic Devices (Stuart Lindsay) experimental and theoretical study of a series of candidate molecular electronic devices.

Brown University - Micro- and Nanomechanics of Electronic and Structural Materials

(http://www.brown.edu/Departments/Advanced_Materials_Research/MRSEC; Director: Clyde Briant)

IRG The Center's research focuses on providing a fundamental understanding necessary for overcoming mechanics of materials limitations to the development of the next generation of electronic and structural materials. Active collaborations exist with industry and are currently enhanced with industrial partners in the opto-electronic sector. The center has developed a series of materials science modules for secondary schools with plans to extend this activity to middle schools.

University of California at Santa Barbara - Center for the Science and Engineering of Materials

(http://www.mrl.ucsb.edu/; Director: Anthony K. Cheetham)

The Center investigates a class of materials that are both chemically and structurally complex with emphasis on interfaces, including those between organic and inorganic materials, and on strongly nonequilibrium phenomena such as deformation, failure, and structural reorganization of complex materials.

IRG 1: Biomaterial Microstructures (Leader: Phil Pincus)
Develop biomaterial microstructures that will perform biological functions, act as building blocks for the processing of hierarchical structures, and serve as model systems for hybrid devices.

IRG 2: Solution Synthesis of Inorganics at Molecular and Atomic Interfaces (Leader: Fred Lange)
Understand the role of structure-directing surfaces in the hierarchical organization of inorganics synthesized from solution at low temperatures, including molecular sieves, mesoporous solids, biomimetic and inorganic-organic materials.

IRG 3: Mesoscopic Macromolecular Structures (Leader: Edward Kramer)
Develop macromolecular structures that are heterogeneous on a mesoscale for electronic and biotechnological applications, including organometallic catalysts and block-copolymer templates.

IRG 4: Strongly Nonequilibrium Phenomena in Complex Materials (Leader: James Langer/Glenn Frederickson)
Focus on deformation and fracture of amorphous and semicrystalline solids, friction and lubrication, complex morphologies generated by reactive processing.

SEED Project 1999-2001: Inorganic self-assembling mask for 2D and 3D ordering of self-assembled semiconductor quantum dots (Petroff/Pine)

SEED Project 2001-2003: Combinatorial Electrochemical Synthesis and Screening of New Mixed Metal Oxide Compositions and Morphologies for Applications in Hydrogen Energy Production (Eric W. McFarland / Martin Moskovits)

California Institute of Technology - Center for the Science and Engineering of Materials

(http://www.csem.caltech.edu/; Director: Julia Kornfield)

The Center supports an interdisciplinary research program on advanced materials, as well as a wide range of educational activities, including outreach to minority communities in California both at the pre-college and college level, and development of pre-college instructional materials.

IRG 1: Biological Synthesis and Assembly of Macromolecular Materials (Leader: David Tirrell)
Investigates aspects of biological synthesis and assembly as they relate to the preparation of macromolecular materials, including use of protein synthesis of microbial cells and development of biomembrane templates to produce polymeric materials.

IRG 2: Bulk Metallic Glasses and Composites (Leader: William Johnson)
Explores new theoretical and experimental approaches to develop bulk metallic glasses and their composites with enhanced mechanical properties, including introduction of crystalline phases to impart resistance to shear localization

SEED Project 1: Mesophotonic Materials (Harry Atwater) Near-term advances in microphotonics and move into the revolutionary domain of devices on scales of tens of nanometers.

SEED Project 2: Ferroelectric Thin films (Kaushik Bhattacharya) Ultrahigh displacement microactuators based on high-strain ferroelectrics, to reveal the microscopic basis of large strain behavior in this class of materials.

Carnegie Mellon University - Materials Research Science and Engineering Center

(http://mimp.mems.cmu.edu/; Director: Gregory Rohrer)

This Center pursues the science and engineering of grain boundaries in polycrystalline solids. Using state-of-the-art experimental and analytical techniques the Center gains information needed to predict how the network of intergranular interfaces evolves and ultimately determines device properties. The Center has extensive collaborations with industry and national laboratories, as well as important international collaborations. An important feature of the educational program is the award of a Collaborative to Integrate Research and Education (CIRE) with Florida A&M University which seeks to increase the participation of underrepresented minorities in science and engineering.

IRG 1: Mesoscale Interface Mapping Project (MIMP) Automated microscopies that utilize image processing and robotic control to record both the crystallography and configuration of interfaces in polycrystals ; Comprehensive mappings of grain boundary properties over their entire range of possible crystallographic structures ; Simulation tools that utilize measured interfacial properties to predict the evolution of the structure of grain boundary networks during grain growth processes.

IRG 2 : Chiral Solids and Surface Project
Synthesis of large area chiral surfaces of a variety of metal and oxide materials by heteroepitaxial growth ; Fundamental understanding of the selectivity of these surfaces for specific adsorption processes, reactions, and crystal nucleation of chiral compounds.

University of Chicago - Materials Center

(http://mrsec.uchicago.edu/index.html; Director: Heinrich M. Jaeger)

The research groups in this MRSEC address fundamental issues of materials and condensed matter science. The Center is highly interdisciplinary, with participants from five departments and from Argonne National Laboratory. In collaboration with the UC Business School, the Center supports a novel program that links industrial firms with science and business students to solve specific problems presented by new products or processes. The Center supports public science education through collaboration with a local museum.

IRG 1: Mesoscopic Self-assembly (Leaders: Heinrich Jaeger, Thomas Witten)
Controlling self-assembled geometry using diblock copolymer thin films and colloidal arrays. Exploiting self-assembly by investigating nanocrystal arrays, metal-decorated diblock copolymers, copolymers with conjugated blocks and novel non-organic electroactive materials.

IRG 2: Quantum Phases, Transitions and Fluctuations (Leaders: Susan Coppersmith, Thomas Rosenbaum)
This IRG aims to understand materials whose exotic and useful properties arise because their statics and dynamics are inextricably mixed, particularly by quantum mechanics and by glassy dynamics.

IRG 3: Macroscopic Dynamics of Materials (Leaders: Todd Dupont, Leo Kadanoff, Sid Nagel)
Macroscopic motion with moving phase boundary, including sonoluminescence, flow of granular materials, crumpling, and contact line precipitation.

IRG 4: Bio-Interfacial Science (Leader: M. Mrksich)
Focus initially on mechanistic studies of the interactions of proteins with interfaces; and the development of surface chemistry techniques for studies of cell-substrate interactions, including cell adhesion and migration.

SEED Project: Nano-Photonics (Heinrich M. Jaeger)
Routes for the self-assembly of highly ordered nanocrystal monolayers and of techniques to pattern these monolayers ; propagation of optical information on sub-wavelengths scales via surface plasmons.

University of Colorado - Ferroelectric Liquid Crystal Materials Research Center

(http://flcmrc.colorado.edu/; Director: Noel A. Clark)

The Center conducts basic and applied research on the phases, structures, and electro-optics of liquid crystals focusing on the roles of chirality and polarization in liquid crystal (LC) behavior, and collaborates with the rapidly developing US ferroelectric display industry. The Center is organized along three main themes: discovery of novel LC phases and materials; study of LC-solid interfaces and its use to control molecular

orientation in LC devices; and development of polymer-liquid crystal composite materials. The Center operates a vigorous education outreach program featuring science shows for the K-12 audience and is developing "Materials Science form CU", a program of classes using materials related topics to teach physical science in K-12 schools throughout the state of Colorado.

IRG 1: Molecular/Macroscopic
Discovery of new LC structural paradigms; understanding the molecular origins of the macroscopic characteristics of LC systems; and the synthesis and physical evaluation of new materials designed to exhibit chosen features of FLC molecular organization.

IRG 2: Interfaces
To develop solid surfaces that can be structurally characterized at the molecular level, and then to probe FLC-solid interfacial structure and interactions. Particular emphasis will be placed on relating the bulk alignment characteristics of SAMs and adsorbed LC monolayers to their structure; on the development of mesogenic SAMs; on the role of chirality in surface structure; and on the creation and evaluation of novel interface structures for SSFLC devices.

IRG 3: Polymers and Gels
To explore the organization of monomers and polymers in LC phases, and to study the effect of LC ordering on polymerization, pursuing the discovery of monomer-structure-dependent nanosegregation made with NSF MRG support. Systems to be studied include acrylate-based FLC-polymer gels, and siloxane and ADMET polymerized side- and main-chain FLC polymers. Emphasis will be placed on creating glassy LCs for NLO applications, probing the structure of FLC gels, and developing gels that combine mechanical rigidity with low switching viscosity.

Columbia University - Mixed Organic/Inorganic Materials

(http://research.radlab.columbia.edu/mrsec/; Director: Irving P. Herman)

Research in the Center addresses the science and technology of heterogeneous thin films formed by arrays of inorganic nanocrystals within polymeric or organic media. Participants from several academic institutions and industrial concerns in the New York metropolitan area strengthen the Center's research and human resources.

IRG : Several approaches are being investigated, including the use of polymers and starburst dendrimers to interconnect nanoparticles. In many cases, these complex films are mixed organic/inorganic structures.

- Novel Synthesis of Nanocrystals (Stephen O'Brien)
- Interparticle Interactions in Self Assembly (Louis Brus)
- Real-time Monitoring of Organic Surface Ligands and Solvent During the Self-Assembly of Nanocrystal Arrays (Irving Herman)
- Self Assembly of Starbrust Dendrimers (Chris Durning)

Cornell University - Center for Materials Research

(http://www.msc.cornell.edu/; Director: Francis Di Salvo)

This broad-based MRSEC seeks to gain a fundamental understanding of ordered and disordered materials at the nanoscale in order to achieve control at these length scales for a variety of potential applications. The center is aided in these tasks by extensive shared facilities and the availability of NSF supported user facilities (CHESS, NNUN). Some of the facilities feature remote- and web-based access for outside users. The center has an effective interaction with the public through a local science museum and addresses the problems of outreach to rural school districts.

IRG 1: Nanostructured Materials: Electron and Spin Transport (Leader:Robert Buhrman)
Examines mechanisms of electron and spin transport in and between nanostructures, including spin-dependent effects in magnetic nanostructures and charge storage in nanocrystallites.

IRG 2: Nanoscale Polymer-Inorganic Hybrid Materials (Leader: Emmanuel Gianellis, Roger Loring)
Combines synthetic strategies, molecular-level physical measurements and computer simulations to design materials with targeted mechanical, thermal and chemical properties

IRG 3: Oxide Glasses: Surfaces and Thin-Film Interfaces (Leader: Dieter Ast, Neil Ashcroft)
Seeks a fundamental understanding of both nano- and intermediate length-scales of the surface of glasses and glass-thin film interfaces.

IRG 4: Fundamentals of Energetic Surface Processing (Leader: Joel Brock)
Studies thin film growth and etching processes by using controlled energetic beams.

IRG 5: Dynamical Mechanical Properties of Nanoscale Materials (Leader: Melissa Hines, Jeevak Parpia)
Seeks to understand energy dissipation mechanisms at the nanoscale and to identify and isolate their non-linear characteristics.

SEED Project 1: Dimensional Evolution of Materials (Abruña)

SEED Project 2 : Electrical Properties and Morphology of Vacuum Deposited Organic Semiconductor Films (Malliaras)

SEED Project 3 : Ordered Macromolecular Structures by Physicochemical Triggering (Ober)

SEED Project 4 : Synthesis of Hybrid Organic-Inorganic Porous Materials and Applications in Asymmetric Catalysis (Lee)

Harvard University - Materials Research Center

(http://www.mrsec.harvard.edu/; Director: Robert Westervelt)

This broad-based Center addresses the interfaces between synthetic and biological systems, electronic microsystems, and micromechanical systems. The Center's educational activities include development of an interdisciplinary materials graduate course and outreach to pre-college students. The Center is playing a role in further developing the Peer Instruction concept through workshops aimed at local K-12 teachers.

IRG 1: Micromechanical Systems (Leaders: J.W. Hutchinson and E. Kaxiras)
The goal is to test and extend the abilities of macroscopic models at smaller size scales, and to improve their connection with microscopic defects.

IRG 2: Engineering Interfaces between Synthetic and Biological Systems (Leader:George Whitesides)
Development of methods for controlling the interface between synthetic and biological materials.

IRG 3: Electronic Microsystems (Leaders: C.M. Lieber and M.G. Prentiss)
Study of new approaches to fabrication of nanoscale electronic devices and the development of physical models of their operation.

SEED Project 1: Study of the Fracture Properties and Fatigue Behavior of Thin Films and Multilayers Using Micromachined Structures (Joost Vlassak)

SEED Project 2 : Fabrication of Nanocrystal Circuits Using Dip-Pen Nanolithography(Hongkun Park)

SEED Project 3 : DNA Molecules as Electronic Devices (Leo Kouwenhoven)

University of Houston - Center for Advanced Oxides and Related Materials

(http://www.uh.edu/mrsec; Director: Allan Jacobson)

The research of this Center advances the basic science and engineering needed to design, synthesize and process new materials for fuel cells, catalytic reactors, and membrane reactors. Emphasis is on the bulk properties, surface structure and reactivity of oxides.

IRG : Synthesis and structure of new oxides with improved properties, relationship between oxide surfaces and chemical reactivity, reactions of oxygen and simple hydrocarbons (e.g. methane) at oxide electrodes and oxygen transport across solid oxide interfaces. We will also study synthesis and processing of ceramic powders and the design and modeling of membrane reactors. Our objective is to achieve improvements in device performance (e.g. lower temperature operation) by enhancing the properties of the individual components and solid interfaces and by integration of new materials into membrane reactor designs.

Johns Hopkins University - Center on Nanostructured Materials

(http://www.pha.jhu.edu/groups/mrsec/main.html; Director: Chia-Ling Chien)

The Center conducts fundamental research on magnetic nanostructures that are likely to be important to technology. The research features materials synthesis with nanometer structural control, advanced characterization techniques, and theoretical studies. The MRSEC has active collaborations with industrial partners, particularly those in the magnetic recording field. Educational outreach is aimed at undergraduates, high school teachers and students, middle school students, and local communities.

IRG: Research in the Center focuses on nanostructures made from novel materials that exhibit enhanced magneto-electronic properties. These include:

- Materials with high spin polarization, especially half-metallic ferromagnets.
- Materials with long carrier mean free path and spin diffusion lengths.
- Heterogeneous layers that exhibit interfacial phenomena.
- Multi-section quasi one-dimensional structures.
- Lithographically patterned arrays of dots, antidots, nanowires, and other structures.
- Nanowires with multi-functionality for chemical and biological applications.

University of Kentucky - Advanced Carbon Materials Center

(http://www.mrsec.uky.edu/; Director: Eric Grulke)

IRG: The Center supports a research program on the synthesis and characterization of carbon nanotubes, fullerines, carbon fibers, pitches and their applications as polymers and composites in devices, structural materials, adsorbents and catalysts. The Center serves as an incubator for start-up companies wishing to exploit research breakthroughs in advanced carbon materials and has outreach activities to industrial and national laboratories and seeks to develop distance learning programs.

University of Maryland, College Park - Center for Oxide Thin Films, Probes and Surfaces

(http://mrsec.umd.edu/; Director: Ellen Williams)

This collaborative between the U. of Maryland and Rutgers U. addresses fundamental problems connected with the dynamics of ferroelectric thin films and surface nanostructures, and with the properties of highly spin polarized magnetic oxides. The MRSEC supports an effective pre-college education outreach effort that includes summer science programs for middle school girls and hands-on math and science student programs.

IRG 1: Polarization Dynamics in Ferroelectric Thin Films (Leader: R. Ramesh)
Studies structure-property relationships that impact the ability to control and optimize the polarization dynamics in thin film ferroelectrics.

IRG 2: Surface Nanostructures: From Fluctuations to Driven Systems (Leader: Ellen Williams)
Experimental and theoretical investigations of the evolution of the nanoscale surface morphology, including electromigration and chemical processing

IRG 3: Metal Oxides with High Spin Polarization (Leader: T. Venkatesan)
Studies metallic oxides with high spin polarization that may be applicable to 'spintronics' and for magnetic field sensing.

University of Massachusetts-Amherst - Center for Polymer Science and Engineering

(http://www.pse.umass.edu/mrsec/; Director: Thomas Russell)

This Center pursues various key areas of polymer science and engineering. The Center has strong ties to industry through it industrial affiliates program, and maintains an effective outreach program that includes research links with near-by women's colleges and development of pre-college educational materials.

IRG 1: Controlled Interfacial Interactions (Leader: T. P. Russell)
Surface and interfacial structures and properties of polymers with emphasis on thin polymer films.

IRG 2: Polymers in Supercritical Fluids (Leaders: J.J. Watkins and H.H. Winter)
This IRG targets heterogeneous polymer/supercritical fluid carbon dioxide systems in which the supercritical fluid is a minor component. Studies of transport, rheology, and solvent-induced phase transitions as well as studies of polymer composites and composite foams.

SEED Project 1: Polymer Synthesis, Fragility and Yielding Under Pressure (J. Penelle)

SEED Project 2: Self-organizing Biomolecular Materials (H. Strey)

Massachusetts Institute of Technology - Center for Materials Science and Engineering

(http://web.mit.edu/cmse/www/; Director: Michael F. Rubner)

This broad interdisciplinary program addresses various areas of fundamental materials research with broad potential for technological applications. There are wide opportunities for undergraduate involvement in research and the Center supports an innovative science and engineering camp for middle school students from the Cambridge public schools.

IRG 1: Microphotonic Materials and Structures (Leader: J.D. Joannopoulos)
Experimental and theoretical investigation of "photonic crystals" created by lithographic patterning of homogeneous semiconductors, primarily silicon and gallium arsenide.

IRG 2: Nanostructured Polymers (Leader: Michael Rubner)
Development of chemistry and processing to control constituents of multicomponent polymers for novel electrical and optical applications.

IRG 3: Electronic transport in Mesoscopic Semiconductor Structures (Leader: Moingi Bawendi)
IRG fcuses on study of fundamental science of transport phenomena in semiconductor heterostructures including lithographically and chemically synthesized nanocrystals and their arrays.

IRG 4: Microstructure and Mechanical Performance of Polymeric Materials (Leader: Mary Boyce)
Design, characterization and modeling of new heterogeneous polymer systems which are likely to possess optimal mechanical properties.

IRG 5: Doped Mott Insulators (Leader: Patrick Lee)
Theory and properties of special transition metal oxides and halides know as "Mott Insulators" in which the motion of electrons is highly correlated and in which doping can induce significant changes of the materials' fundamental properties.

SEED Project 1: Tuning the Emission Wavelength and Improving the Efficiency of Organic LEDs through Nanostructuring of Materials (Vladimir Bulovic)

SEED Project 2: Novel Fibers for Efficient Transmission of Electromagnetic Waves and Optical Devices (Yoel Fink)

SEED Project 3: Chemical Control of the Spatial Position of Quantum Dots in Thin Film Composites (Klavs F. Jensen)

SEED Project 4: Phonon-Polaritonic Bandgap Crystals (Keith Nelson)

SEED Project 5: The Ideal Kagomé Lattice: Synthesis and Magnetism of Pure and Single-Crystalline Jarosite-Type Compounds (Daniel G. Nocera)

SEED Project 6: Order in Strongly Interacting Quantum Many Particle Systems (Senthil Todadri)

SEED Project 7: Actin: Paradigm for Active Polymeric Materials (Alexander van Oudenaarden)

Michigan State University - Center for Sensor Materials for Control and Diagnostics

(http://www.pa.msu.edu/csm; Director: Brage Golding)

The Center targets research on sensor materials and sensing technology, and collaborates actively with groups from the automotive industry. The Center has outreach efforts that address science education at all levels.

IRG 1: Photonic Sensing Materials (Leader: M. Koochesfahani)
Synthesis and characterization of new materials suitable for sensitive detection of chemical species using optical, mass, and conductimetric transduction techniques. Application of molecular based diagnostic techniques to measurement of turbulent flow within internal combustion engines.

IRG 2: Electronic Sensing Materials (Leader: W.P. Pratt)
Focus is on growth, processing and characterization of materials suitable for physical sensors, including magnetic multilayers and diamond.

University of Minnesota - Materials Research Science and Engineering Center

(http://www.mrsec.umn.edu/; Director: Michael D. Ward).

The research in this MRSEC focuses on hybrid materials, that is materials produced by arranging multiple components into composite structures to achieve applications that are oherwise unattainable. Topics addressed include microstructured polymers, artificial tissue, magnetic heterostructures, and porous materials. The Center supports a strong educational outreach program to numerous colleges in the Upper Midwest, with emphasis on outreach to the Native American community in the region.

IRG 1: Microstructured Polymers (Leader: Timothy P. Lodge)
Synthesis, characterization, processing, and theory of hybrid polymer materials. Specific research areas include water-compatible block copolymers, the super-strong segregation regime, modified macromolecular crystallinity, nanostructured composites, adhesion and mechanical response of interfacial materials.

IRG 2: Artificial Tissue (Leader: Robert T. Tranquillo)
Focus is on materials science of artificial tissues and materials for use in biosystems. Specific areas include composition-structure-mechanical property relationships of tissues, cell-based tissue synthesis and processing, and novel tissue biomolecular materials.

IRG 3: Magnetic Heterostructures (E. D. Dahlberg)
Interfacial phenomena between magnetic and nonmagnetic materials. Control of interfacial structure is important for electron spin coupling and polarized spin transport in magnetic heterostructures. Initial research project areas include polarized spin transport in magnetic/superconductor heterostructures and coupling magnetic/non-magnetic metallic heterostructures.

Seed Project 1 : porous materials (M.D. Ward) To design and synthesize organic and inorganic porous frameworks, and to elucidate the common principles responsible for their formation and stability

Northwestern University - Materials Research Center

(http://mrcemis.ms.nwu.edu/; Director: Robert Chang)

The Center supports an interdisciplinary research program on materials with an emphasis on the nanoscale. The Center features a strong pre-college educational program, including the widely disseminated Materials World Modules (MWM), as well as outstanding undergraduate and graduate educational opportunities. Of particular interest is the Master's Materials Technology Program, which prepares graduates to teach materials science concepts at the community college level.

IRG 1: Nanostructured Materials for Chemical and Biological Sensing (Leader: George Schatz)
Focus on developing and characterizing materials for nanoparticle-based sensors.

IRG 2: Complex Oxides for Photonics (Leader: Thomas Mason)
Investigates the processing-structure-property relationships of thin film complex oxides for linear and non-linear optical applications.

IRG 3: Molecular Mechanisms of Environmentally Benign Polymer Processing (Leader: Linda Broadbelt, John Torkelson)
Focuses on new polymer systems achieved through environmentally friendly compatibilization of blends or synthesis, and on resource recovery from spent polymers.

IRG 4: Architecture, Transport, and Binding in Molecular Crystals, Polyelectrolyte, Nanocomposites, and Nanoscale Structures (Leader: Mark Ratner)

Studies the relationship of structure, charge transport and device function in extended systems based on assembled molecular architectures.

SEED Project 1: Atomic level processes in self-assembly (Mark Asta)

SEED Project 2: Growth and synchrotron X-ray analysis of nanostructures (Michael Bedzyk)

SEED Project 3: Synchrotron analysis of organic ultra-thin layers (Pulak Dutta)

SEED Project 4: Electrical measurements of thin films and nanostructures (Carl Kannewurf)

SEED Project 5: Nonlinear optical & excitonic properties of oxide films and nanostructures (John Ketterson)

SEED Project 6: Continuum theory of nano-dot formation (Peter Voorhees)

University of Oklahoma/University of Arkansas - Center for Semiconductor Physics in Nanostructures

(http://www.uark.edu/depts/microep/MRSEC/mrsec%20home.htm; Director: Matthew Johnson)

The Center, a collaboration between the Universities of Oklahoma and of Arkansas, supports an interdisciplinary research program on semiconductor nanostructure science and applications. The Center is engaged in a number of educational activities from the graduate to the middle school level, including support for workshops for middle and high school science teachers.

IRG 1: Nanostructures - Growth and Characterization (Leader: Gregory Salamo)
Focuses on the fabrication of semiconductor nanostructures through self-assembly, epitaxially or in bulk through colloidal growth, and selective area growth.

IRG 2: Nanoscale Interface Studies (Leader: Michael Santos)
Studies narrow gap semiconductor surfaces and interfaces at the atomic level to gain an understanding of interfacial properties that limit the room temperature performance of such heterostructures.

University of Pennsylvania - Laboratory for Research on the Structure of Matter

(http://www.lrsm.upenn.edu/; Director: Michael Klein)

The Center supports a broad interdisciplinary research program on complex nanostructures and materials. The MRSEC is also developing innovative methods of instruction. It is linked to the University of Puerto Rico through a Collaborative to Integrate Research and Education (CIRE) and hosts a large program for undergraduates and teachers.

IRG 1: Functional Biomolecular Materials (Leader: Kent Blasie, Leslie Dutton)
Develops principles for de novo protein design directed to creating protein building blocks for performing natural and novel functions.

IRG 2: Carbon Nanotube-Derived Materials (Leader:John Fischer, Alan Johnson)
Focuses on the synthesis, assembly and theory of higher-order structures created from single-wall carbon nanotubes.

IRG 3: Microscale Soft Materials (Leader:Daniel Hammer, Arjun Yodh)
Focuses on design and control of self-assembled colloidal systems with tailored optical and mechanical properties.

IRG 4: Multifunctional Complex Oxides (Leader: Dawn Bonnell, I.-Wei Chen)
Designs, synthesizes, characterizes and models novel materials that exhibit highly sensitive responses to combinations of stress with external electric and magnetic fields.

SEED Project 1: Polymer Membranes and New Morphologies in Thin Film Polymer Blends (Composto)

Penn State University - Center for Porous Hosts

(http://www.mrsec.psu.edu/; Director: Moses Chan)

The research in this Center focuses on the collective molecular, photonic and electronic effects that emerge in nanometer-scale porous systems of one-, two- and three-dimensional connectivity. Industrial interaction is implemented through industrial symposia and student internships. The education efforts seek training of teachers and encourage innovative educational contributions of the MRSEC faculty and students. Collaborations with the Franklin Institute and local public radio stations are designed for developing outreach programs.

IRG:

- Tunable photonic materials. Fundamental questions of design and application in novel strain-tunable and optically-tunable photonic systems based on colloidal crystal replicas with high-strain ferroelectric polymers, strongly nonlinear liquid crystal infiltrants, and high-index composite nanoparticle/polymer components.
- Fluid phase transitions: confinement vs. Disorder. Phase transitions in a fluid confined within a porous host are qualitatively different from those in a bulk fluid. The great majority of experiments to date, using random porous media such as porous glasses, cannot disentangle the effects of confinement from those of disorder. *Ordered* porous hosts with controllable degrees of connectivity, tunable pore diameters and functionalizable surfaces enables one to access these new experimental variables; this same degree of order also enables a very tight comparison with simulation.
- Electronic properties of infiltrated metals. The ability to fundamentally change the underlying electronic properties of elemental metals through confinement in ordered 1-D or 3-D hosts, i.e. synthesizing "new metals from old atoms."

Princeton University - Center for Complex Materials

(http://www.princeton.edu/%7Epccm/ ; Director: Ravindra N. Bhatt)

The components of the Center pursue a common theme of synthesizing and characterizing mesoscopically structured, complex materials by a variety of approaches with current emphasis on low-dimensional electronic materials, macromolecular soft materials, organic thin films and photonic devices, and bioinspired composites. The Center has a strong outreach program to pre-college students and teachers and to local museums.

IRG 1: Unusual Phases and Excitations in Low-dimensional Electronic Materials (Leaders:R.N. Bhatt and N.P. Ong)
Theoretical and experimental studies of electronic and magnetic excitations in 2D electron systems, high Tc superconductors, spin chain systems, and organic conductors.

IRG 2: Organic Thin Films and Quantum Structures (Leader: S.R. Forrest)
Growth and characterization of organic crystalline layers using vapor phase and molecular beam techniques for potential applications in photonic devices.

IRG 3: Amphiphilic Polymers: Functional Materials through Self Assembly (Leader: W.B. Russel)
Creation and characterization of novel materials through the self-assembly of block and graft copolymers with emphasis on nanolithography, templating of nanoporous solids, control of interfacial forces, and associated solutions.

IRG 4: Design and Processing of Bioinspired Composites (Leader: I.A. Aksay)
Application of lessons from biology to the creation of synthetic composites with unique properties. Pursuit of the enabling science for producing structures similar to those in biogenic hard materials via self-assembly at the nanometer scale coupled with lamination and patterning at the microscopic scale.

Stanford University/IBM-Almaden/University of California-Davis -- Center for Polymer Interfaces and Macromolecular Assemblies

(http://www.stanford.edu/group/CPIMA/ ;Director: Curtis Frank)

This Center is a university/industry partnership among groups from Stanford University, IBM Almaden Research Laboratory, and the University of California-Davis. Research addresses the interfacial science of organic thin films with potential applications in optical and electro-optical devices, lubrication, and adhesion

CPIMA's educational outreach programs aim to bring aspects of CPIMA research to the attention of K-12, undergraduate, graduate students and the public in general.

IRG 1: Structure and Dynamics of Polymer Interfaces (Leaders: Craig Hawker, Eric Shaqfeh)
This IRG aims to develop a fundamental understanding of the structure and dynamics of polymers tethered or confined to an interface through covalent attachment or physical adsorption.

IRG 2: Membranes (Leaders: Marjorie Longo, Steven Boxer)
The goal is to explore the material properties of interfacial thin film membranes formed from combinations of polymers, lipo-polymers, and low molecular weight amphiphiles.

IRG 3: (Seed IRG) (Leader: Robert Miller)
The goal of this seed IRG is to understand the structure, dynamics, and properties of interfaces that are buried within complex, multicomponent, and/or multiphase systems with 10 to 100 nm feature sizes.

SUNY at Stony Brook - Center for Novel Materials by Thermal Spray

(http://www.matscieng.sunysb.edu/tsl/ctsr ;Director: Herbert Herman)

Research focuses on thermal spray coatings, which are crucial to the operation of many engineering components and systems. A major initiative of the Center is to develop theoretical and experimental tools for processing and characterization of functional deposits with coupled mechanical/electrical and mechanical/magnetic properties. The Center has a strong industrial outreach program, which creates mutually beneficial relationships between the MRSEC and the industrial sector. The program also provides opportunities for students to be involved in internship programs and is especially targeted to encourage minority students to enter the field. The collaborations with National Labs are extensive and involve a significant number of faculty members and students.

IRG 1: Processing science and modeling of traditional and novel materials
Particle-Flame Diagnostics ; On-Line Control ; Modeling Deposit Formation ; Solidification/Microstructure Development ; Process & Parametric Maps ; Synthesis of New Materials & Processes.

IRG 2 : Advanced characterization and modeling techniques to evaluate the materials science of thermal spray deposits. Microstructures & Phases ; Interfacial Structures & Chemistry ; Adhesion & Cohesion ; Porosity & Imperfections ; Residual Stresses and its Generation ; Thermo-Mechanical Behavior.

SUNY at Stony Brook/Polytechnic University/CUNY - Center for Polymers at Engineered Interfaces

(http://polymer.matscieng.sunysb.edu/ ; Director: Miriam Rafailovich)

The MRSEC is a collaboration between SUNY Stony Brook, the City University of New York, Polytechnic University and several other academic and industrial partners. The Center has a vigorous educational program from the graduate to the elementary school level. Recent innovations include an enhanced interdisciplinary graduate curriculum, undergraduate programs partnering with existing programs to enhance participation of women and underrepresented minorities, a model high school program which actively incorporates outstanding students into the research process, and new activities at the elementary school level which seek to develop and apply inquiry-based modules.

IRG: The focus of the Center is the design of polymer thin film properties through precise control of interfacial structure. The uniqueness of the investigations is the synthesis and study of engineered interfaces. At these interfaces, molecular-level control of surface energy via chemical functionalities, symmetry, and order is accomplished. A central goal of this Center is to address technological problems related to polymer thin films, and to develop cutting-edge enabling technologies that take existing polymeric systems and markedly improve their properties.

University of Wisconsin-Madison - MRSEC on Nanostructured Materials and Interfaces

(http://mrsec.wisc.edu/ ; Director: Thomas Kuech)

The Center carries out research on the detailed formation, characterization, and exploitation of materials at the nanoscale. As part of its educational initiative, the Center actively participates in producing instructional materials for integrating materials science and engineering into pre-college, college, and graduate curricula.

IRG 1: Fundamental Issues in Materials Integration on Silicon (Leader: Max Lagally)
Focuses on heteroepitaxial growth and developing new processing techniques for materials integration at the mesoscopic to the nanoscale range. n in-situ and real-time characterization techniques.

IRG 2: Critical Grain BoundaryProperties of High Temperature Superconductors for Applications (Leader: David Larbelestier)
Investigates the structure, chemistry and electrical properties of grain boundaries with the aim of controlling and improving electrical transport.

IRG 3: Nanostructured Materials as Interfaces to Biology (Leader:Nicholas Abbott)
Investigates polymeric materials with nanoscale topography and patterned surface chemistry that controls the surface interactions of proteins and cells.

SEED Project 1: Ceramic Nanocomposites

SEED Project 2: Nanoparticles composites

University of Virginia - Center for Nanoscopic Materials Design

(http://www.mrsec.virginia.edu/ ; Director: Robert Hull)

The Center investigates guided growth processes of semiconductor surfaces with the purpose of assembling highly perfected nanoscale structures. Potential applications include quantum dot electronics, biological templating, and nanoscale control of electrochemical reactions. Industrial and academic partners are closely integrated into the research plan. The educational outreach program emphasizes students at smaller universities and community colleges in the Commonwealth.

Seed Project 1 : The development of new experimental probes and modeling techniques for elucidating the coupling of short and medium range alloy in metallic alloy systems that can evolve into crystalline, amorphous, nanocrystalline and crystalline states.

Seed Project 2 : Electronucleation of gel structures onto nano-scaled conducting surfaces, offering the promise of control of internal gel structure, through adjusting pore dimensions to the length scales of the underlying conducting sites at which gelation is initiated.

Seed Project 3 : The use of nanostructured surfaces for controlled adhesion of protein structures.

Classement des centres MRSECs par thème

Groupes de Recherches	Université
Biomolecular / Biomimetic Materials	
Biomaterial microstructures (http://www.mrl.ucsb.edu/mrl/research/irg1.html) Biomimetic synthesis, interfaces, porous materials (http://www.mrl.ucsb.edu/mrl/research/irg2.html)	University of California at Santa Barbara
Biosynthesis of macromolecular materials (http://www.csem.caltech.edu/bio.html)	California Institute of Technology
Bio-interfacial science (http://mrsec.uchicago.edu/research.html#irg4)	University of Chicago
Interfaces between synthetic and bio systems (http://www.mrsec.harvard.edu/research/IRG_2.html)	Harvard University
Artificial tissues (http://www.mrsec.umn.edu/mrsec/artificialtissues.shtml)	University of Minnesota
Functional biomolecular materials (http://www.lrsm.upenn.edu/lrsm/IRG_1.pdf)	University of Pennsylvania
Bioinspired composites (http://www.princeton.edu/~pccm/IRGIV.htm)	Princeton University
Biomolecular membranes (http://www.stanford.edu/group/CPIMA/irg/irg_b.htm)	Stanford/IBM/UC Davis
Nanostructured materials as interfaces to biology (http://mrsec.wisc.edu/IRG3/Index.html)	University of Wisconsin-Madison
Coatings / Ceramics	
Complex oxides for photonics (http://mrcemis.ms.nwu.edu/mrc_new/oxidesframe.html)	Northwestern University
Multifunctional complex oxides (http://www.lrsm.upenn.edu/lrsm/IRG_4.pdf)	University of Pennsylvania
Thermal spray coatings, synthesis of oxides (http://www.matscieng.sunysb.edu/tsl/ctsr/research.html)	SUNY at Stony Brook - Thermal Spray
Condensed Matter Phenomena	
Mesoscopic self-assembly, colloids, polymers (http://mrsec.uchicago.edu/research.html#irg1) Tunable quantum materials (http://mrsec.uchicago.edu/research.html#irg2)	University of Chicago
Ferroelectric liquid crystals (http://flcmrc.colorado.edu/research.html)	University of Colorado
Doped Mott insulators (http://web.mit.edu/cmse/www/IRGmain.html#5)	Massachusetts Institute of Technology
Collective phenomena in porous hosts (http://www.mrsec.psu.edu/)	Pennsyvania State University
Phases and excitations in low D electronic materials (http://www.princeton.edu/~pccm/IRG1.htm)	Princeton University
Magnetic / Ferroelectric Materials and Structures	
Thin Film Materials for ultra-high density data storage (http://bama.ua.edu/~mint/IRG1.html) Particulate materials for ultra-high density data storage (http://bama.ua.edu/~mint/IRG2.html)	University of Alabama
Polarization dynamics in ferroelectric thin films (http://mrsec.umd.edu/IRGs/IRG1.html) Metal oxides with high spin polarization (http://mrsec.umd.edu/IRGs/IRG3.html)	University of Maryland
GMR / diamond / magnetic and electronic sensing (http://www.pa.msu.edu/csm/research/index.html)	Michigan State University
Magnetic heterostructures, spintronics (http://www.mrsec.umn.edu/mrsec/magnetichetero.shtml)	University of Minnesota

Nanostructures	
Structural integrated films containing nanoparticles (http://www.cise.columbia.edu/mrsec/research.html)	Columbia University
Nanostructured materials: electron and spin transport (http://www.ccmr.cornell.edu/research/index.shtml) Dynamic mechanical properties of nanoscale materials (http://www.ccmr.cornell.edu/research/index.shtml)	Cornell University
Electronic Microsystems (http://www.mrsec.harvard.edu/research/IRG_3.html	Harvard University
Magnetic, supercon., granular systems (http://www.pha.jhu.edu/groups/mrsec/03/index.html)	Johns Hopkins University
Carbon nanotubes, synthesis and processing (http://www.mrsec.uky.edu/)	University of Kentucky
Nanostructured polymer assemblies (http://web.mit.edu/cmse/www/IRGmain.html#2) Electronic transport in mesoscopic semiconductors (http://web.mit.edu/cmse/www/IRGmain.html#3)	Massachusetts Institute of Technology
Nanostructured materials for chem. and biol. sensing (http://mrcemis.ms.nwu.edu/mrc_new/sensorsframe.html) Polyelectrolyte nanocomposites and structures (http://mrcemis.ms.nwu.edu/mrc_new/nanocompositeframe.html)	Northwestern University
Semiconductor nanostructures-growth and charact. Nanoscale interface and magneto-electronics	Universities of Oklahoma/Arkansas
Carbon nanotube-derived materials (http://www.lrsm.upenn.edu/lrsm/IRG_2.pdf)	University of Pennsylvania
Nanoscopic design, quantum dots, surfaces (http://mrsec.wisc.edu/IRG3/Index.html)	University of Wisconsin-Madison
Mechanics of Materials	
Micro-and nanomech.; electronic / structural materials (http://www.brown.edu/Departments/Advanced_Materials_Research/MRSEC/research.htm)	Brown University
Bulk metallic glasses and composites (http://www.csem.caltech.edu/bmg.html)	California Institute of Technology
Grain boundaries, metals / ceramics; simulations (http://mimp.mems.cmu.edu/mimp.html)	Carnegie Mellon University
Micromechanical systems (http://www.mrsec.harvard.edu/research/IRG_1.html)	Harvard University
Nonequilibrium Phenomena	
Strongly nonequilibrium phenomena in complex materials (http://www.mrl.ucsb.edu/mrl/research/irg4.html)	University of California at Santa Barbara
Macroscopic dynamics of materials (http://mrsec.uchicago.edu/research.html#irg3)	University of Chicago
Photonic sensing / turbulent flow (http://www.pa.msu.edu/csm/research/index.html)	Michigan State University
Organic Systems, Colloids	
Microscale soft materials- (http://www.lrsm.upenn.edu/lrsm/IRG_3.pdf)	University of Pennsylvania
Organic MBE/MOCVD, thin films, quantum structures (http://www.princeton.edu/~pccm/IRGII.htm)	Princeton University
Polymers	
Mesoscopic macromolecular structures (http://www.mrl.ucsb.edu/mrl/research/irg3.html)	University of California at Santa Barbara
Nanoscale polymer-inorganic hybrid materials (http://www.ccmr.cornell.edu/research/ResAccomplPlans/irg-b.pdf)	Cornell University

Controlled interfacial interactions (http://www.pse.umass.edu/mrsec/irg1.html) Polymers in supercritical fluids (http://www.pse.umass.edu/mrsec/irg2.html)	University of Massachusetts
Microstructure and mech. performance of polymers (http://web.mit.edu/cmse/www/IRGmain.html#4)	Massachusetts Institute of Technology
Benign polymer processing (http://mrcemis.ms.nwu.edu/mrc_new/polymerframe.html)	Northwestern University
Amphiphilic polymers: self-assembly (http://www.princeton.edu/~pccm/IRGIII.htm)	Princeton University
Macromolecular architectures (http://www.stanford.edu/group/CPIMA/irg/irg_a.htm)	Stanford/IBM/UC Davis
Polymers at engineered interfaces (http://polymer.matscieng.sunysb.edu/)	SUNY at Stony Brook - Garcia Polymer
Semiconductors / Photonics	
Wide-gap films (http://mrsec.la.asu.edu/irgs/irg2.html)	Arizona State University
Microphotonic Materials & Structures (http://web.mit.edu/cmse/www/IRGmain.html#1)	Massachusetts Institute of Technology
CVD growth / materials integration on silicon (http://mrsec.wisc.edu/irg1/index.html)	University of Wisconsin-Madison
Synthesis / Processing	
High pressure synthesis (http://mrsec.la.asu.edu/irgs/irg1.html)	Arizona State University
Fundamentals of energetic surface processing (http://www.ccmr.cornell.edu/research/ResAccomplPlans/irg-d.pdf)	Cornell University
Advanced oxides / fuel cells (http://www.uh.edu/mrsec/)	University Houston
Surfaces, Layers, Interfaces	
Oxide glasses: surfaces and thin film interfaces (http://www.ccmr.cornell.edu/research/ResAccomplPlans/irg-c.pdf)	Cornell University
Surface nanostructures, dynamics (http://mrsec.umd.edu/IRGs/IRG2.html)	University of Maryland
Critical grain boundaries in HTS for applications (http://mrsec.wisc.edu/irg2/index.html)	University of Wisconsin-Madison

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Voici la liste des directeurs de chaque centre : (http://www.mrsec.org/centers/directors_2001.11.php3)

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Installations scientifiques expérimentales : *Facilities*

Voici ci-dessous la liste, classée par technologie, des installations d'équipements scientifiques expérimentaux (*facilities*), financés par la NSF à travers les centres MRSECs :

Computing/Simulation
Arizona State University (http://mrsec.la.asu.edu/s-fac.html)
University of California at Santa Barbara (http://www.mrl.ucsb.edu/mrl/centralfacilities/centralfacilities.html)
California Institute of Technology (http://www.csem.caltech.edu/facilities.html)
University of Chicago (http://mrsec.uchicago.edu/facilities.html)
University of Colorado (http://flcmrc.colorado.edu/Sharedfacilities.html)
Cornell University (http://www.ccmr.cornell.edu/facilities/facilities.html)
University of Kentucky (http://www.mrsec.uky.edu/facility/facility.htm)
University of Massachusetts (http://www.pse.umass.edu/mrsec/shared.html)
University of Pennsylvania (http://www.lrsm.upenn.edu/lrsm/facilities.html)
Pennsylvania State University (http://www.mrsec.psu.edu/facilities/)
Princeton University (http://www.princeton.edu/%7Epccm/sharedfacilities.htm)

Crystal Growth
Massachusetts Institute of Technology (http://web.mit.edu/cmse/www/sefs.html)
Northwestern University (http://mrcemis.ms.nwu.edu/mrc_new/facilitiesframeset.htm)

CVD
Michigan State University (http://www.pa.msu.edu/csm/shared/index.html)
University of Wisconsin (http://mrsec.wisc.edu/Facilities.html)

Electron Magnetic Resonance
Northwestern University (http://mrcemis.ms.nwu.edu/mrc_new/facilitiesframeset.htm)

Electron Microscopy
Arizona State University (http://mrsec.la.asu.edu/s-fac.html)
Brown University (http://www.brown.edu/Departments/Advanced_Materials_Research/MRSEC/)
University of California at Santa Barbara (http://www.mrl.ucsb.edu/mrl/centralfacilities/centralfacilities.html)
California Institute of Technology (http://www.csem.caltech.edu/facilities.html)
Carnegie Mellon University (http://mimp.mems.cmu.edu/facs.html)
University of Chicago (http://mrsec.uchicago.edu/facilities.html)
Columbia University (http://www.cise.columbia.edu/mrsec/user.html)
Cornell University (http://www.ccmr.cornell.edu/facilities/facilities.html)
Harvard University (http://www.mrsec.harvard.edu/facilities.html)
University of Houston (http://www.uh.edu/mrsec/mrsec_facilities.html)
University of Massachusetts (http://www.pse.umass.edu/mrsec/shared.html)
Northwestern University (http://mrcemis.ms.nwu.edu/mrc_new/facilitiesframeset.htm)
University of Pennsylvania (http://www.lrsm.upenn.edu/lrsm/facilities.html)
University of Virginia (http://www.mrsec.virginia.edu/shared/index.html)

Engine Research Lab
Michigan State University (http://www.pa.msu.edu/csm/shared/index.html)

Focused Ion Beam
University of Virginia (http://www.mrsec.virginia.edu/shared/index.html)

High Pressure Synthesis
Arizona State University (http://mrsec.la.asu.edu/s-fac.html)

Ion Beam
Arizona State University (http://mrsec.la.asu.edu/s-fac.html)
University of Chicago (http://mrsec.uchicago.edu/facilities.html)
Cornell University (http://www.ccmr.cornell.edu/facilities/facilities.html)

Image Analysis and Processing
University of Chicago (http://mrsec.uchicago.edu/facilities.html)
Princeton University (http://www.princeton.edu/%7Epccm/sharedfacilities.htm)

Laser Cutting Facility
University of Wisconsin (http://mrsec.wisc.edu/Facilities.html)

Low Energy Electron Microscope
University of Wisconsin (http://mrsec.wisc.edu/Facilities.html)

Low Temperature Lab
University of Chicago (http://mrsec.uchicago.edu/facilities.html)
Northwestern University (http://mrcemis.ms.nwu.edu/mrc_new/facilitiesframeset.htm)
Pennsylvania State University (http://www.mrsec.psu.edu/facilities/)

Magnetic Characterization
University of Alabama (http://bama.ua.edu/~mint/exper.html)

Magneto-Optic Imaging
University of Wisconsin (http://mrsec.wisc.edu/Facilities.html)

Materials Processing/Preparation
University of Alabama (http://bama.ua.edu/~mint/exper.html)
University of Chicago (http://mrsec.uchicago.edu/facilities.html)
Cornell University (http://www.ccmr.cornell.edu/facilities/facilities.html)
Harvard University (http://www.mrsec.harvard.edu/facilities.html)
Johns Hopkins University (http://www.pha.jhu.edu/groups/mrsec/07/)
Northwestern University (http://mrcemis.ms.nwu.edu/mrc_new/facilitiesframeset.htm)

Mechanical Testing
Brown University (http://www.brown.edu/Departments/Advanced_Materials_Research/MRSEC/)
California Institute of Technology (http://www.csem.caltech.edu/facilities.html)
Northwestern University (http://mrcemis.ms.nwu.edu/mrc_new/facilitiesframeset.htm)
University of Pennsylvania (http://www.lrsm.upenn.edu/lrsm/facilities.html)
SUNY Stony Brook (http://www.matscieng.sunysb.edu/tsl/ctsr/facilities.html)
SUNY/Polytechnic/CUNY (http://polymer.matscieng.sunysb.edu/facilities.html)

Microfabrication/Microelectronics/Clean Room
University of Alabama (http://bama.ua.edu/~mint/exper.html)
Brown University (http://www.brown.edu/Departments/Advanced_Materials_Research/MRSEC/)
California Institute of Technology (http://www.csem.caltech.edu/facilities.html)
University of Colorado (http://flcmrc.colorado.edu/Sharedfacilities.html)
Columbia University (http://www.cise.columbia.edu/mrsec/user.html)
Harvard University (http://www.mrsec.harvard.edu/facilities.html)
Michigan State University (http://www.pa.msu.edu/csm/shared/index.html)
University of Minnesota (http://www.mrsec.umn.edu/mrsec/main.html)
University of Virginia (http://www.mrsec.virginia.edu/shared/index.html)

MBE
Brown University (http://www.brown.edu/Departments/Advanced_Materials_Research/MRSEC/)

Near Field Scanning Microwave Microscope
University of Maryland (http://mrsec.umd.edu/SEF.html)

Neutron Scattering/Diffraction
University of Chicago (http://mrsec.uchicago.edu/facilities.html)
University of Pennsylvania (http://www.lrsm.upenn.edu/lrsm/facilities.html)

NMR
Arizona State University (http://mrsec.la.asu.edu/s-fac.html)
California Institute of Technology (http://www.csem.caltech.edu/facilities.html)
University of Pennsylvania (http://www.lrsm.upenn.edu/lrsm/facilities.html)

Nucleic Acid Facility
University of Pennsylvania (http://www.lrsm.upenn.edu/lrsm/facilities.html)

Optical Microscopy
Arizona State University (http://mrsec.la.asu.edu/s-fac.html)
University of Colorado (http://flcmrc.colorado.edu/Sharedfacilities.html)
Cornell University (http://www.ccmr.cornell.edu/facilities/facilities.html)
University of Massachusetts (http://www.pse.umass.edu/mrsec/shared.html)
University of Pennsylvania (http://www.lrsm.upenn.edu/lrsm/facilities.html)
Pennsylvania State University (http://www.mrsec.psu.edu/facilities/)

Orientation Imaging Microscopy
Carnegie Mellon University (http://mimp.mems.cmu.edu/facs.html)

Polymer Synthesis/Characterization
University of California at Santa Barbara (http://www.mrl.ucsb.edu/mrl/centralfacilities/centralfacilities.html)
California Institute of Technology (http://www.csem.caltech.edu/facilities.html)
University of Colorado (http://flcmrc.colorado.edu/Sharedfacilities.html)
Cornell University (http://www.ccmr.cornell.edu/facilities/facilities.html)
University of Minnesota (http://www.mrsec.umn.edu/mrsec/main.html)
University of Pennsylvania (http://www.lrsm.upenn.edu/lrsm/facilities.html)
SUNY/Polytechnic/CUNY (http://polymer.matscieng.sunysb.edu/facilities.html)

Powder Synthesis and Characterization
SUNY Stony Brook (http://www.matscieng.sunysb.edu/tsl/ctsr/facilities.html)

Protein Expression
University of Chicago (http://mrsec.uchicago.edu/facilities.html)

Pulsed Laser Deposition
University of Maryland (http://mrsec.umd.edu/SEF.html)

Rutherford Backscattering
Cornell University (http://www.ccmr.cornell.edu/facilities/facilities.html)
University of Maryland (http://mrsec.umd.edu/SEF.html)

SIMS
Arizona State University (http://mrsec.la.asu.edu/s-fac.html)

Spectroscopy
University of California at Santa Barbara (http://www.mrl.ucsb.edu/mrl/centralfacilities/centralfacilities.html)
University of Chicago (http://mrsec.uchicago.edu/facilities.html)
University of Colorado (http://flcmrc.colorado.edu/Sharedfacilities.html)
University of Massachusetts (http://www.pse.umass.edu/mrsec/shared.html)
Michigan State University (http://www.pa.msu.edu/csm/shared/index.html)

Surface Preparation/Characterization
University of Alabama (http://bama.ua.edu/~mint/exper.html)
Arizona State University (http://mrsec.la.asu.edu/s-fac.html)

Carnegie Mellon University (http://mimp.mems.cmu.edu/facs.html)
University of Chicago (http://mrsec.uchicago.edu/facilities.html)
University of Colorado (http://flcmrc.colorado.edu/Sharedfacilities.html)
Harvard University (http://www.mrsec.harvard.edu/facilities.html)
University of Houston (http://www.uh.edu/mrsec/mrsec_facilities.html)
Johns Hopkins University (http://www.pha.jhu.edu/groups/mrsec/07/)
University of Massachusetts (http://www.pse.umass.edu/mrsec/shared.html)
Massachusetts Institute of Technology (http://web.mit.edu/cmse/www/sefs.html)
University of Minnesota (http://www.mrsec.umn.edu/mrsec/main.html)
University of Pennsylvania (http://www.lrsm.upenn.edu/lrsm/facilities.html)
Stanford University/IBM/CalDavis (http://www.stanford.edu/group/CPIMA/facilities/index.htm)

Synchrotron Beam Line
Arizona State University (http://mrsec.la.asu.edu/s-fac.html)
Northwestern University (http://mrcemis.ms.nwu.edu/mrc_new/facilitiesframeset.htm)
University of Wisconsin (http://mrsec.wisc.edu/Facilities.html)

Thermal Spray Systems
SUNY Stony Brook (http://www.matscieng.sunysb.edu/tsl/ctsr/facilities.html)

Thin Film Fabrication and Characterization
Stanford University/IBM/CalDavis (http://www.stanford.edu/group/CPIMA/facilities/index.htm)

Tribology Laboratory
SUNY Stony Brook (http://www.matscieng.sunysb.edu/tsl/ctsr/facilities.html)

Turbulent Mixing Laboratory
Michigan State University (http://www.pa.msu.edu/csm/shared/index.html)

UHV STEM
Columbia University (http://www.cise.columbia.edu/mrsec/user.html)
Cornell University (http://www.ccmr.cornell.edu/facilities/facilities.html)
Harvard University (http://www.mrsec.harvard.edu/facilities.html)
University of Maryland (http://mrsec.umd.edu/SEF.html)

X-ray Diffraction
Brown University (http://www.brown.edu/Departments/Advanced_Materials_Research/MRSEC/)
University of California at Santa Barbara (http://www.mrl.ucsb.edu/mrl/centralfacilities/centralfacilities.html)
California Institute of Technology (http://www.csem.caltech.edu/facilities.html)
University of Chicago (http://mrsec.uchicago.edu/facilities.html)
University of Colorado (http://flcmrc.colorado.edu/Sharedfacilities.html)
Cornell University (http://www.ccmr.cornell.edu/facilities/facilities.html)
University of Houston (http://www.uh.edu/mrsec/mrsec_facilities.html)
University of Massachusetts (http://www.pse.umass.edu/mrsec/shared.html)
Massachusetts Institute of Technology (http://web.mit.edu/cmse/www/sefs.html)
Northwestern University (http://mrcemis.ms.nwu.edu/mrc_new/facilitiesframeset.htm)
University of Pennsylvania (http://www.lrsm.upenn.edu/lrsm/facilities.html)
SUNY/Polytechnic/CUNY (http://polymer.matscieng.sunysb.edu/facilities.html)