

The Mutual Benefit of International Research Interactions

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Outline

- 1. Why we need to increase international scientific interactions? Aims and immediate goals.
- 2. The benefit so far: Evidence of successful programs.
- 3. What to do next?

Einstein “The Credo” (1932)

- I am often worried at the thought that my life is based to such a large extent on the work of my fellow human beings and I am aware of my great indebtedness to them.....

The Credo reveals a passion for truth and social justice, and a distaste for clubmanship and elitism. Science is an opportunity in the world to connect us.

Reciprocity is essential for science to survive:

We have the responsibility to support scientists abroad.

The mutual benefit is clear. Science is a team effort

- Einstein “On the moral obligation of the scientist” (1950)

Example

- Korea: Industries and Universities have generated a generation of well trained scientists/engineers and technology.

In about 20 years their living conditions improved dramatically and our scientific and technological knowledge increased.

A Humanitarian “Why ?”

- Science, technology and education in developed countries have changed *the human condition* (1), including increasing the life expectancy.
- In underdeveloped parts of the world, the human condition has not changed in accordance with available knowledge.
- A better world can be supposed applying science and technology everywhere. HOW?

(1) Hannah Arendt, *The Human Condition*

Aims and Immediate Goals

- **Share scientific discoveries**
 - International workshops
 - Other forms of distribution of knowledge and interaction such as exchange programs,...
- **Support scientists abroad**
 - Acknowledge their work
 - Invite them to give talks,...
- **Enhance scientific interactions**
 - Give fair opportunities to international postdocs and visitors abroad to participate in our research programs

Existing Programs

- Education exchange programs (**sponsored by NSF**; UNESCO educational programs, Trieste and Brazil Summer Schools).
- Workshops
- The Web

Undergraduate Research Partnerships

Single Institution – Single Institution

- 11-week research experience for undergraduates in Cork Ireland, Tyndall National Institute
- NSF supplement to Northwestern University-MRSEC grant and Ireland funds
- **Pre-existing infrastructure at Tyndall (they initiated the program)**
 - SUNY Stony Brook Center for Thermal Spray Research: sends Stony Brook undergraduates to Czech Technical University & Institute of Plasma Physics in Prague



ACS International REU

Network of Sites – Network of Sites

- American Chemical Society partnering with German Academic Exchange Service and European Chemistry Thematic Network
- 10-week summer research opportunity, starting 2008
- 15 US chemistry students going to Germany, Italy, France or UK
- 18 European students coming to US Chemistry REU sites
- **Takes advantage of existing REU site structure**
- This program is funded by the U.S. NSF, the German Academic Exchange Service (Deutscher Akademischer Austausch Dienst – DAAD), and participating European Chemistry Thematic Network institutions.

- [information from ACS website \(acs.org\)](http://acs.org)

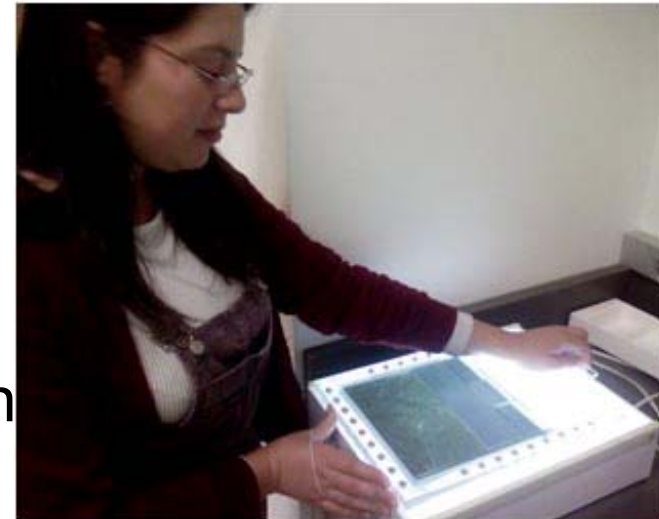


Deutscher Akademischer Austausch Dienst
German Academic Exchange Service

Student Exchange

Single US University – Multiple International Sites

- undergraduate and graduate students exchanged between University of Chicago MRSEC and institutions in Chile: University of Chile and the University of Santiago
- **NSF supplemental grant covers travel for US participants and living expenses for Chilean students, started 2003**
- Collaborative research in nonlinear phenomena (**Find topic of research!!**)
- students spend 10 weeks abroad
- 6-7 students from each side per year
- MRSEC coordinates logistics and funding
- **information from UChicago MRSEC website** and Professor Thomas Witten, University of Chicago



US Graduate Students, Postdocs Working Abroad

Single US University – Multiple International Sites

- Northwestern Nanoscale Science and Engineering Center (NSF-funded) received supplemental grant to send US graduate students and postdocs to conduct research abroad
- in 2007, 13 students and postdocs participated (12 to Europe, 1 to Asia).
- In previous years only 2-3 students. WHY? Open to other science/eng. Disciplines, using NSEC structure
- length of visit: 1 to 2 months
- visits based on individual PI international collaborations
- Center coordinated logistics, recruited participants, centralized funding
- information from NU-NSEC NSF award number EEC-0118025

International Workshops

International Materials Institute – NSF

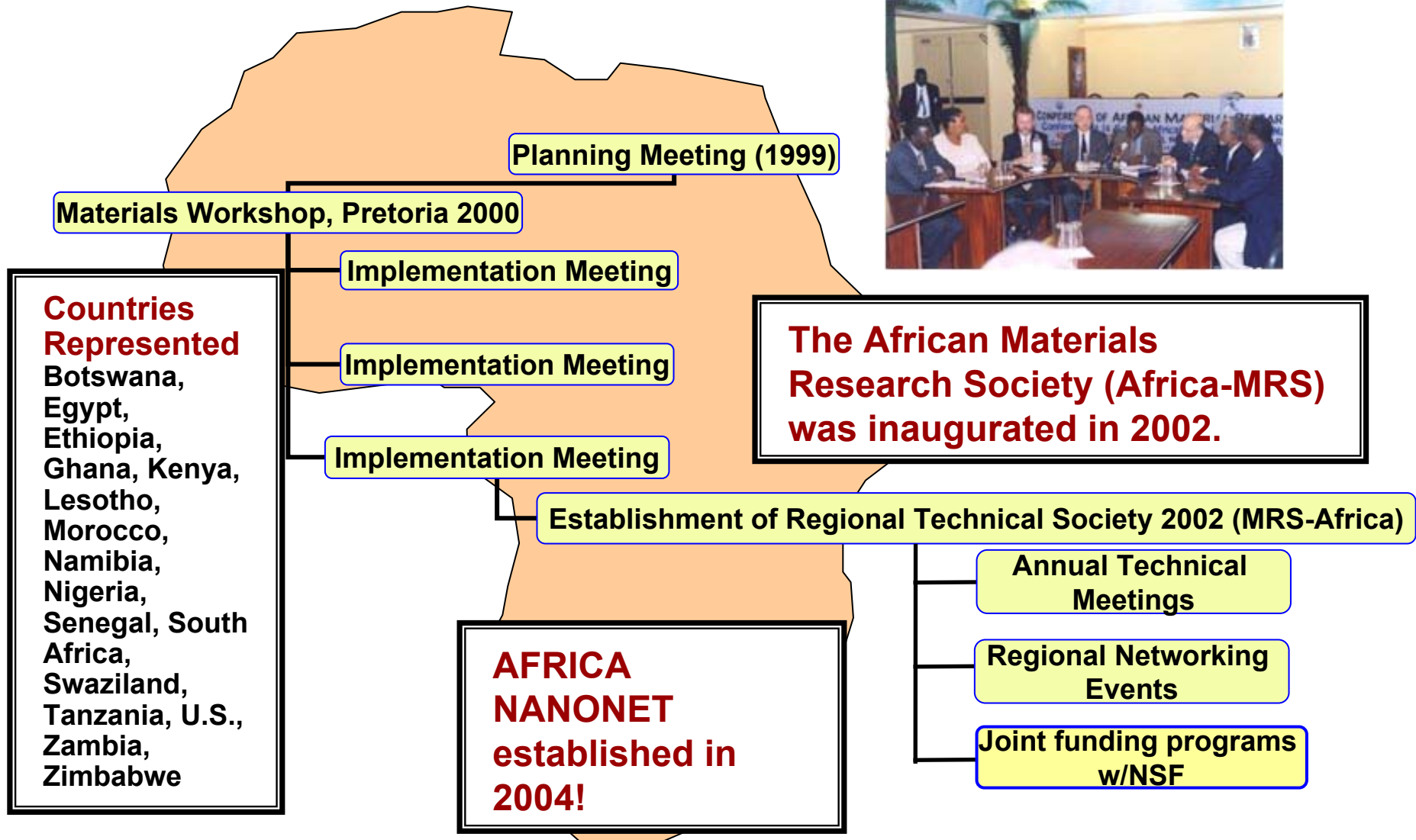
- Workshop on **DFT** Applied to Metals and Alloys
- The 3rd International Workshop on DFT Applied to Metals and Alloys in Oran , Algeria.
- First meeting to bring large scale participation of N. African and Middle Eastern scientists with US and European scientists (including **Nobel Laureate** Prof. W. Kohn)
- The program served to inaugurate an international collaborative project for materials design using both electronic structure calculations and materials informatics. **The meeting used the cyberinfrastructure platform to enhance international participation**



May 2-4, 2007

International Workshops

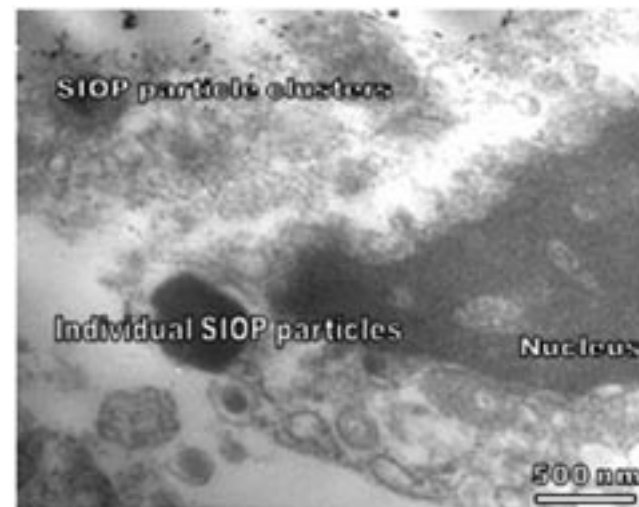
Materials World Network – NSF



Scientific Exchange

US – Africa Materials Institute

- ***Integration of African researchers in emerging collaborations that advance the frontier of fundamental materials research and impact multidisciplinary fields such as **health and medicine*****
- 9-week research fellowships for US and Africa scientists
- **Institute helps establish laboratories in Africa**
- Interdisciplinary team from the US (Princeton, Louisiana State, Pennington Biomedical), Uganda, Tanzania, Senegal, and Nigeria
- **Synthesized and functionalized magnetic nanoparticles for cancer cell detection.**



Microscopic images of nanoparticles attached to breast cancer tissue

Information from NSF, Carmen Huber, IMI Program Officer and Institute web site

International Workshops for Graduate Students

Global School for Advanced Studies

- Mission:
 - Develop Global Leadership Capabilities in young scientists and engineers
 - Foster new research synergies in critical global challenge areas
- **Session on Advanced Solar Cell Research**
 - Hsinchu and Taipei, Taiwan, September 19-29, 2006
 - competition: winning team had members from Japan, South Africa, US, Philippines, and Taiwan.

Pre- Session:

Teams formed, background reading; Project Planning begins

Advanced Lectures (R&D, manufacturing, tech transfer, policy, etc.

Team Project Planning & Expert Mentoring

Team Presentations & Project Review

Post-Session:

Best project is implemented via Team Research Fellowship at ITRI, Taiwan!



International Workshop for Graduate Students

Pan-American Advanced Studies Institute

Argentina, Bolivia, Brazil, Canada, Chile, Mexico,
Panama, Peru, Venezuela, and the US.

- Lecturers from Academia, Industry, and Government
- Eight Pan-American Student Teams
- Teams planned collaborative research and prepared funding proposals
- Mentoring from lecturers
- Student experience in international team building and project development
- Pan-American relationships
- **New research topics**



Directly Addressing Economic Needs in Developing Countries

International Materials Institute (IMI)
International Center for Materials Research,
Nicola Spaldin, UCSB
Biofuel from Jatropha in Rural Mali

- Supports the Engineers Without Borders at UCSB. They began a project which involves the enhancement of Jatropha cultivation and oil processing capabilities into rural villages in Mali in order that they can produce their own biodiesel fuel.
- Jatropha is an oil-bearing plant that has a high yield of vegetable oil that can be used with minimal processing in combustion engines.
- **US students learn to develop engineering solutions to immediate energy problems in multicultural settings**



Information
at NSF,
Carmen
Hubber

Complementary Scientific Skills

International Mats. Institute for New Functionality in Glass

Synthesis

Synthesis via sol-gel route
MSE, U of Lisbon, Portugal

Synthesis via melt-quench-heat-etch route
MSE, Lehigh U. ↔ MSE, Alexandria U, Egypt

Basic material characterization

Characterization of porosity,
phases, morphology, dissolution
MSE, Lehigh U

Mechanical strength Mechanical, U.
Delaware ↔
MSE, Obafemi Awolowo U Nigeria

Cell-glass interactions

Cell-glass adhesion
**ME&AS, Princeton U ↔
Physics, Dakkar U, Senegal**

Effect of glass on osteoblast cell behavior
**Biology, Lehigh U ↔ Tissue Eng.,
Alexandria, Egypt**

Animal/human testing

In vivo testing
Tissue Eng., Alexandria U, Egypt

- Research and educational activities
- International exchanges
- Faculty sabbatical
- International conference travel scholarship
- Mission: Focus, coordinate and promote educational and research activities across the globe to introduce new functionality in glass

Information from Himanshu Jain, Lehigh Univ.



Complementary Scientific Skills Materials World Network

Thomas Mason at NU has an NSF Materials World Network grant that involves exchange of personnel between Northwestern (bulk ceramic specimen preparation/ characterization) and **the Darmstadt University of Technology** (thin film preparation, in situ and ex situ photoelectron spectroscopy, XPS/UPS).



The DAISY-MAT System: Darmstadt University of Technology

As part of this exchange, bulk and thin film specimens are being evaluated for surface electronic structure (Fermi level, work function).

-Dedicated to surface (XPS/UPS) studies of conductive oxides

International Scientist Visiting US Individual University Partnerships

- The Brain Korea 21 (BK21) is a research-oriented educational program between Ajou University and Northwestern University Materials Research Center
- interdisciplinary group of 26 professors at Ajou University in the fields of nanotechnology, biotechnology and medicine
- professors and pre-doctoral fellows visit Northwestern for several months at a time
- NU professors visit Korea for several days each year
- Ajou-NU exchanges since 2005
- 2 joint publications in 2006



Funding: Korea. Facilities: NU-MRSEC

University of Latvia – Northwestern Partnership

Funding from US (NSF-MRSEC)

- Scientists from Theoretical Laboratory at Institute of Solid State Physics collaborate with Northwestern University
- Supplemental funding for visitors from NSF
- Latvian scientists work at Northwestern for several months each year
- collaboration since 2004
- computational study of absorption on metal oxide surfaces
- **10 submitted joint papers in 4 years**



Supporting Pre-College Education

Translating Teaching Modules into Spanish

- Five of the popular Materials World Modules Program (MWM) were recently translated into Spanish.
- These modules use an inquiry-based, student-centered approach to introducing materials science and demonstrating the field's connection to the real world.
- The modules have been used by 35 schools, including 120 teachers, 1200 students, and 7 cities and towns, in the state of Chihuahua, Mexico.
- Four of the modules have been introduced to educators in Puerto Rico. (Support provided by the NASA Space Consortium.)
- information from NU-MRSEC 2007 highlight



Taking Advantage of the Internet

- Websites that are part of Research Centers' educational outreach programs are available to the international community
- Cornell Center for Materials Research: Ask-a-Scientist
<http://www.ccmr.cornell.edu/education/ask/>
- University of Wisconsin – Madison MRSEC:
Exploring the Nanoworld
online educational resources
demonstration ideas, kits, videos
<http://www.mrsec.wisc.edu/Edetc/index.t>



Scientific Collaboration over the Internet

Materials Digital Library

- The **NSDL MatDL Pathway** (matdl.org) aims to provide stewardship for content and services needed across the MS community and in particular for its targeted audience of materials undergraduate and graduate students, educators, and researchers by offering:
 - 1. Tools, like the Repository and [Soft Matter Wiki](#), to describe, manage, exchange, archive, and disseminate data among national and international government-funded materials teams and centers.
 - 2. [MatForge](#) for open access development of modeling and simulation tools.
 - 3. [Teaching Archive](#) for collaborative development of core undergraduate MS teaching materials.
 - 4. Services and content for [Virtual Labs](#) in large undergraduate introductory science courses
- Funded by NSF (DUE-0532831, PI: Laura Bartolo, Kent State)

Successful Programs

- Engaging research with short term benefits
- Funded NSF Center are successful due to infrastructure and mandate
- Finding the contacts involves personal experience (a PhD student who returned home or an international scientist who stayed in the US)
- Appropriate funding from the countries involved

What to do next?

- Insist in graduate student international experiences
- Design courses in the web that can be accessed by scientists in underdeveloped Countries
- Incorporate the work of scientist abroad in our community

What next? Cont.

- Expert information available to general public abroad: Possible mechanisms to provide scientific information to communities without the cost of journals
- Fair evaluation of the work of scientists abroad and acknowledgment of their work