New Materials Synthesis and Crystal Growth (MSAC)

SSSC Meeting
Beckman Center of the National Academies
Irvine, CA
October 19, 2007

Chaired by Paul Peercy (University of Wisconsin at Madison)

Genesis

- In December 2006, the National Academies convened the MSAC Committee
  - DOE and NSF provided support for the project

- The committee is tasked as follows:

1. Define the research area of MSAC, framing the activities in the broader context of the condensed-matter and materials sciences.
2. Assess the health of the collective U.S. research activities in MSAC.
3. Articulate the relationship between synthesis of bulk and thin-film materials and measurement-based research activities; identify appropriate trends.
4. Identify future opportunities for MSAC research and discuss the potential impact on other sciences and society in general.
5. Recommend strategies to address these opportunities, including discussion of the following issues:
   - Establishment of new organizations to improve accessibility to and distribution of samples
   - Transfer technology from basic research to commercial processes
   - Identification of essential elements of national materials synthesis capabilities and considerations for nationally organized efforts.

MSAC Committee Membership

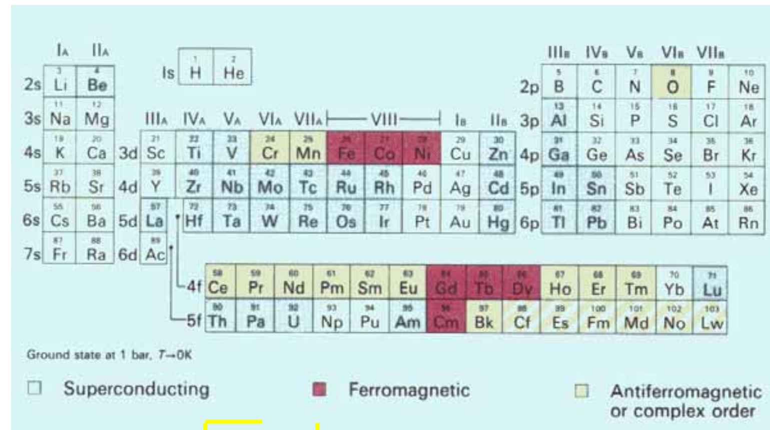
Paul S. Peercy, *Chair*, University of Wisconsin, Madison
Collin L. Broholm, Johns Hopkins University
Robert J. Cava, Princeton University
James R. Chelikowsky, University of Texas, Austin
Zachary Fisk, University of California, Irvine
Patrick D. Gallagher, National Institute of Standards and Technology
Laura H. Greene, University of Illinois, Urbana-Champaign
Eric D. Isaacs, Argonne National Laboratory
Peter B. Littlewood, University of Cambridge
Laurie E. McNeil, University of North Carolina, Chapel Hill
Joel S. Miller, University of Utah
Loren Pfeiffer, Alcatel-Lucent
Ramamoorthy Ramesh, University of California, Berkeley
Arthur P. Ramirez, Alcatel-Lucent
Hidenori Takagi, University of Tokyo
Dan J. Thoma, Los Alamos National Laboratory

Sketch of Work Plan

- In-person meetings will be held to gather data, involve the community, generate ideas, hold discussions, and build consensus
  - 3 Town hall meetings to date (APS, MRS, ICCG)
  - 2 committee meetings held, 1 or 2 more planned
- The target release date for the approved prepublication draft is June 2008
  - Final editing, design, layout, illustration, and publication by the National Academies Press will occur afterward
- Public E-mail Box: msac@nas.edu
  (all input received posted on committee website)
- Committee website:
  http://www7.nationalacademies.org/bpa/MSAC_Home.html

What are New Materials and Crystal Growth?

New compound discovery – Chemists, physicists, and materials scientists combine different atomic constituents in different ratios to achieve novel structures, and novel functionalities. Often the first realization of a compound is in polycrystalline form.



Crystal growth – To eliminate effects of grain boundaries (e.g. scattering light or charge and loss of directionality) growth of single crystals is necessary.

Study Context

- The basic research effort of U.S. industry is waning, and with it, the domestic capability for creating new materials and growing them in crystalline form suitable for characterization and analysis.
- U.S. materials characterization capabilities are very strong and growing.
- The opportunity to exploit strong U.S. characterization capabilities for the identification of materials with new properties is constrained by the limited domestic supply of new materials.
- Strong capabilities for new materials creation have emerged in Japan and Europe, placing the United States at a competitive disadvantage.

Community Context

- Many existing crystal grower-measurer relationships were established by physically working near each other in current or former positions.
- There are a small number of active crystal growers but their breadth and impact is large.
- MSAC has become more active internationally.

Questions for Discussion: Education, Training, Academia

- Does the U.S. need specific training programs in MSAC (summer schools, graduate programs,…) for young and established researchers?
- How does one address the cultural perception of crystal growers?
- What is the academic home for MSAC (physics, chemistry, materials science,…)? What is the effect of disciplinary organization of U.S. universities?

Questions for Discussion: Industry and Government

- What made the industrial labs so successful and how can the federal agencies foster that environment and resulting impact? What were particularly important attributes?
- What is the role of national laboratories in MSAC?
- What are the needs of industry and how should they be addressed?

Questions for Discussion: Structural Issues

- How do we increase sample availability and / or connect growers and measurers?
- What kinds of infrastructure needs does this community have?
- How does one determine the right size of the US crystal growth effort ($, people,…)?
- How does one quantify whether this field is supply-limited or demand-limited? How can one show that a growth in MSAC would be absorbed by the scientific community and not result in needless duplication?

Questions and Comments