

Ethnic Diversity in Materials Science and Engineering

A REPORT ON THE WORKSHOP ON ETHNIC DIVERSITY
IN MATERIALS SCIENCE AND ENGINEERING

December 9-11, 2012 | Arlington, Virginia

SPONSORED BY:

National Science Foundation
Department of Energy Office of Science
University Materials Council
MRS Foundation
North Carolina State University

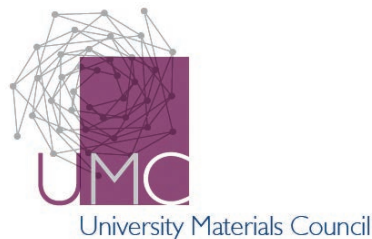


Table of Contents

Workshop Summary	1
Current Status Tables	2
Summary of Recommendations	4
Action Plans	7
Commonly Referenced Agencies and Programs by Acronym	8

SESSION SUMMARIES

Session 1: Unconscious Bias & Climate Issues	9
Session 2: Panel of Deans	11
Session 3: Issues Faced by Female Minorities	12
Session 4: Role and Needs of Minority Serving Institutions	14
Session 5: IMPACT Program Overview	17
Session 6: Retention, Mentoring and Success	19
Session 7: Results from Graduate Student Survey	22
Session 8: Perspectives of Graduate Students and Young Faculty	27
Session 9: Keynote Address - Federal Government Perspective	29

APPENDICES

Appendix A: Post-Workshop Feedback	30
Appendix B: Materials Science and Engineering Graduate Student Survey	34
Appendix C: Materials Science and Engineering Recent Graduate Survey	36
Appendix D: Attendee List	37
Appendix E: Useful References	40

Workshop Summary

BACKGROUND

Statistics clearly show that academic participation in and employment of ethnically and racially diverse individuals in Materials Science and Engineering (MSE) are statistically very low. The primary focus of The Workshop on Ethnic Diversity in Materials Science and Engineering was issues that affect recruitment and retention and long-term success in MSE, from the undergraduate level and preparation for graduate school, through graduate school, and beyond to success in the workforce — both in academia and in national laboratories.

LEADERSHIP

The workshop was chaired by Justin Schwartz, Head of the Department of Materials Science and Engineering at North Carolina State University (NCSU), with co-organizers Viola Acoff, Head, Department of Metallurgical and Materials Engineering, University of Alabama; Rudy Buchheit, Chair of the Department of Materials Science and Engineering at Ohio State University and Chair of the University Materials Council (UMC); Darryl Butt, Chair, Department of Materials Science and Engineering, Boise State University; Ramón Collazo, Assistant Professor of Materials Science and Engineering, NCSU; Javier Garay, Associate Professor of Mechanical Engineering, University of California Riverside; Olivia Graeve, Associate Professor of Mechanical and Aerospace Engineering, University of California San Diego (formerly Alfred University); Marcia Gumpertz, Professor of Statistics and Assistant Vice Provost of Institutional Equity and Diversity; NCSU, Frank Hunte, Assistant Professor of Materials Science and Engineering, NCSU; and Sasha Ishmael, post-doctoral research associate, NCSU



Workshop Chair, Justin Schwartz (North Carolina State University) addresses the workshop participants in the opening session.

FUNDING

Funding for the workshop was provided by the National Science Foundation¹ the United States Department of Energy, the Materials Research Society Foundation, the University Materials Council and North Carolina State University.

WORKSHOP GOALS

The immediate goal of the workshop was to elevate and identify issues and challenges that have impeded participation of diverse individuals in MSE. The longer-term goals are to continue forward by gathering and disseminating data, launching and tracking initiatives to mitigate the impediments, and increase the number of diverse individuals pursuing degrees and careers in MSE. The larger goal, however, is to create over time an ever-increasing number of role models in science fields who will, in turn, draw others in to contribute to the workforce of the future.

PARTICIPANTS

In total, 125 attendees registered for the workshop, including graduate students and a number of post-doctoral scientists. The workshop also brought together critical personnel who may influence progress in the topic area, including:

- administrators of MSE departments at universities and national laboratories, deans of a number of engineering colleges, political leaders, social scientists, psychologists and members of the community with the knowledge to comment on the key issues,
- National Science Foundation, Department of Energy and Department of Defense staff and administrators, and minority scientists at various stages of their careers.



Workshop participants discuss issues faced by female minorities during a break-out session.

¹ This material is based upon work supported by the National Science Foundation under grant number DMR-1252518 and the United States Department of Energy under grant number DE-SC0009285

STRUCTURE

The workshop consisted of a series of keynote speeches, topical presentations, panel-led discussions, and working breakout groups to identify the underlying challenges and provide recommendations for policy changes to address the challenges. Specific sessions included the following:

- Unconscious Bias and Climate Issues
- Panel of Deans
- Issues Faced by Female Minorities
- The Role and Needs of Minority-Serving Institutions
- IMPACT Program Overview
- Retention, Mentoring and Success
- Graduate Student Survey Results
- Graduate Students and Young Faculty Perspectives
- Keynote Address by Congresswoman Eddie Bernice Johnson

IMPACT

The immediate impact of the project is the engagement of the materials community in the important discussion about ethnic diversity. This is not a problem that will be solved overnight, but the workshop was an important early step in raising awareness of the problem and the challenges faced. By raising awareness, and disseminating the final report broadly, the impact of the workshop will permeate the community. Furthermore, by including a large number of graduate students with a wide range of ethnic backgrounds, the workshop began to lay the groundwork for transformative change. It is also anticipated that the underlying messages of the final report will be applied to other scientific and engineering disciplines, further expanding the impact of the workshop.

PRODUCTS

In addition to the impact of 120 workshop participants carrying their learning on the topic into their home environments, this comprehensive workshop report will be widely disseminated by hard copy and electronically in 2014. A summary of the Workshop was reported in the MRS Bulletin.

The report is structured with specific recommendations, aimed at key stakeholders, summarized first subjectively, action plans for the future, followed by detailed summaries of the workshop sessions. Last, results from a preliminary survey and useful references are provided. Workshop documents, such as the conference agenda, participant list, etc., are appended.

Current Status of Racial and Ethnic Minorities in Materials Science and Engineering

TABLE 1: Data for 'Metallurgical and Materials. Engineering' Programs from the ASEE Database for US Engineering Schools PhD Degrees

PHDs	Total	African- Am	Asian- Am	Hispani c	Native Am	Pacific Isle	Cauc	Foreign	Other	Two or More	Unkn	Male	Female
Number													
2007	584	4	38	3	0	0	169	338	32	0	0	427	157
2011	623	6	40	10	2	0	167	345	0	5	48	474	149
	39	2	2	7	2	0	-2	7	-32	5	48	47	-8
Percent													
2007	584	1.6%	15.4%	1.2%	0.0%	0.0%	68.7%	57.9%	5.5%	0.0%	0.0%	73.1%	26.9%
2011	623	2.2%	14.4%	3.6%	0.7%	0.0%	60.1%	55.4%	0.0%	0.8%	7.7%	76.1%	23.9%
	6.7%	0.5%	-1.1%	2.4%	0.7%	0.0%	-8.6%	-2.5%	-5.5%	0.8%	7.7%	3.0%	-3.0%

TABLE 2: Data for 'Metallurgical and Materials. Engineering' Programs from the ASEE Database for US Engineering Schools B.S. Degrees

B.S.	Total	African -Am	Asian- Am	Hispan Am	Native Am	Pacific Isle	Caucasian Am	Foreign	Other	Two or More	Unk	Male	Female
Number													
2007	1005	23	124	48	3	2	660	55	0	3	87	710	295
2011	1295	30	141	52	3	2	767	83	0	9	208	925	370
	290	7	17	4	0	0	107	28	0	6	121	215	75
Percent													
2007	1005	2.4%	13.1%	5.1%	0.3%	0.2%	69.5%	5.5%	0.0%	0.3%	8.7%	70.6%	29.4%
2011	1295	2.5%	11.6%	4.3%	0.2%	0.2%	63.3%	6.4%	0.0%	0.7%	16.1%	71.4%	28.6%
	28.9%	-0.1%	1.5%	0.8%	0.1%	0.1%	-3.4%	1.1%	-6.6%	1.2%	5.3%	2.7%	-2.7%

TABLE 3: MSE Faculty Data for 'Metallurgical and Materials. Engineering' Programs from the ASEE Database for US Engineering Schools B.S. Degrees

	Total Tenure/Tenu re Track MSE Faculty	Male	Female	Af- Amer	As- Amer	Hispan ic	Nat Amer	Nat Haw	Cauc	Other	Unk.	Af- Amer+Hisp+ Nat Amer+Nat Haw
Number												
2007	789	683	106	13	178	20	1	0	551	26	0	34
2011	852	730	122	19	187	23	0	4	563	0	52	46
Diff	63	47	16	6	9	3	-1	4	12	-26	52	12
2007	789	86.6%	13.4%	1.6%	22.6%	2.5%	0.1%	0.0%	69.8%	3.3%	0.0%	4.3%
2011	852	85.7%	14.3%	2.2%	21.9%	2.7%	0.0%	0.5%	66.1%	0.0%	6.1%	5.4%
Diff	8.0%	-0.9%	0.9%	0.6%	-0.6%	0.2%	-0.1%	0.5%	-3.8%	-3.3%	6.1%	1.1%

Summary of Recommendations

These recommendations were compiled from the workshop discussions and a follow-up survey sent to participants.

- 1. Individuals:** Become culturally competent through awareness of and intentional efforts to overcome unconscious bias and stereotyping. Seek interaction with professionals from different demographic groups. Specific actions may include the following:
 - Replace your self-image as an objective person with recognition and acceptance that you are subject to the influence of bias and assumptions.
 - Learn about unconscious or explicit bias by taking an Implicit Association Test (IAT) from Project Implicit (<https://implicit.harvard.edu/implicit/>).
 - Participate in educational programs or workshops on Implicit or Unconscious Bias offered by your department, or other professional organizations.
 - Practice Stereotype Replacement: Reflect on your own judgments and interactions (and those of others around you) and assess whether bias or assumptions played a role.
 - When you recognize the activation of stereotypical portrayals (e.g., women aren't good at mathematics), replace it with a non-stereotypical response (e.g., research does not support a gender difference in math performance when we control for the number of math courses taken).
 - Engage in Counter-stereotype Imaging: Surrounding yourself with counter-stereotype images can prevent stereotyped responses. E.g.: Display in your office, hallways, and course materials, pictures or photographs of women and members of racial or ethnic minorities who have made important contributions to or are currently working in your field.
 - Practice Perspective Taking: Do not rely solely on your own perceptions of department or campus climate. Rather, adopt the perspective of a member of a stigmatized group. For example, imagine what it would be like to:
 - ii. Have your abilities or competence repeatedly questioned.
 - iii. Not be offered opportunities because of assumptions about what you would be interested in or willing to consider.
 - iv. Not receive the same rewards and recognitions as similarly deserving peers.
 - Take advantage of opportunities for professional interaction with members of underrepresented groups.
 - Meet and talk with members of underrepresented groups presenting at or attending academic conferences.
 - Pursue opportunities for collaboration in research and teaching with members of underrepresented groups.
 - Engage in outreach work in diverse communities.
 - Mentor and advocate for students and colleagues from underrepresented groups.

- 5. Academic Leaders:** Take responsibility for implementing cultural, organizational and systemic changes within your span of control, including within your institution and externally through professional organizations. Examples include:
 - Encourage more participation from Minority Serving Institutions (MSI) programs and departments by the University Materials Council (UMC).
 - Include appropriate discussions at faculty meetings by department heads (DHs). A source of materials that can be used by DHs needs to be developed and made freely available. The development of these materials should be funded by the NSF, UMC, MRS, and/or the appropriate entity.
 - Establish faculty mentorship training to mentor post-docs and graduate students. The training should include issues related to being conscious of equal treatment to all students/post-docs.
 - Fully integrate and involve members of underrepresented groups in all aspects of the organizational experience. Working with the leadership of professional societies, academic leadership should take more steps to make institutions and organizations more welcoming to all.
 - Create PhD programs with the specific aim of training for faculty positions in MSE. University department heads and deans at MSIs should pursue appropriate minority faculty recruitment and assignment with adequate faculty development and support systems in place to maximize the chances of success with retention and tenure.
 - Work towards the alignment of MSI aspirations and strategic vision with the vision of federal funding agencies through collaboration with department heads and deans at MSIs.
 - Develop and promote high standards for civil engagement with all people in the workplace.
 - Establish the expectation that all members of a department, school, or college treat each other with dignity and respect and that inequitable treatment will not be tolerated.
 - Promote these policies by personal example.

- Hold departmental members accountable for violating basic standards of respect, consideration, and politeness by assessing these factors during performance evaluations and relying on these assessments when making committee assignments, recommendations for awards and honors, and more.
- Build an inclusive community.
- Meet with students, scientific staff, and faculty who belong to underrepresented groups and consult with them to learn more about their experiences, the challenges they face, and the suggestions they believe are needed to improve climate.
- Examine departmental (or college-wide) committees and ensure that leadership and membership are diverse with respect to age, gender, nationality, race, and ethnicity. Assess whether department teaching assignments, lab space, office space, and other resources are appropriately and equitably distributed.
- Examine department or college-wide events such as seminar series and sponsored conferences and make sure they include presenters of various ages, genders, nationalities, races, and ethnicities.
- Encourage returning faculty and staff to welcome and collaborate with new faculty and staff.
- Personally introduce new faculty and staff to department or campus colleagues with shared interests. Encourage new faculty to seek out colleagues in other departments and offer to make introductions.
- Encourage women and minority faculty to take advantage of campus-wide mentoring and networking opportunities.
- Recognize and value the work of departmental members.
- Publicly recognize and praise faculty, staff, and students who perform work on behalf of the department. Be sure to attribute credit accurately.
- Make public announcement of awards and recognitions received by departmental members (faculty, staff, postdocs, and students). Evaluate departmental recommendations for awards and honors and ensure that bias is not inadvertently playing a role.
- Encourage all faculty and students to become aware of the academic contributions of their colleagues in the department and, when relevant, to cite these contributions in the publications and presentations.
- Conduct regular pay equity reviews to ensure that women and minorities receive fair compensation.
- Encourage balance between work and family or personal responsibilities.
- Foster inclusiveness in scheduling departmental/college-wide meetings. Recognize that parents may not be able to attend early morning or late afternoon meetings.
- Develop creative and flexible solutions to accommodate family and personal responsibilities. Invite faculty and staff to suggest solutions and learn about accommodations other departments have made.
- Budget for lecturers and other staff members needed for family and/or medical leave.
- Pay attention to retention, tenure, and promotion of women and minority faculty, staff, and students.
- Ensure that women and minority faculty receive adequate mentoring — they frequently do not receive the informal mentoring enjoyed by men and majority faculty. Encourage women and minority faculty to seek out mentors within and outside the department and help facilitate the development of mentoring relationships when possible.
- Ensure that the isolation and alienation many women and minority faculty experience is not mistaken for or criticized as “not being collegial” or “not being a team player” particularly during evaluations for tenure and promotion.
- Ensure that women and minority faculty are not subject to higher expectations for number and quality of publications than are men and majority faculty. Be aware that unintentional bias and assumptions can influence evaluations.
- Ensure that women and minority faculty members, staff, and students are not disproportionately burdened with committee and other service obligations.
- Respond to complaints and concerns.
- Listen respectfully to complaints and concerns about treatment or policies in the department or college.
- If the complaint references another member of the department, hold a separate meeting with that individual to address and assess the concern and, when possible, avoid identifying any individual/s who complained. In discussions with both parties focus on solutions and means of improving the situation rather than dwelling on blame and ill treatment.



Workshop participants listening to one of the workshop presentations.

- If the complaint includes illegal behaviors and harassment, learn about your campus's policies and procedures for responding to and reporting such complaints. Consult early and often with campus representatives knowledgeable in this area.
- Hire or otherwise identify role models for faculty and for students. In the Hispanic community, the strongest role models are senior Hispanic faculty, for junior faculty, and faculty at any rank for students. These faculty not only communicate with the students, but many of them can also speak Spanish to parents. Among Hispanics, the older generations are often much more comfortable with Spanish. When someone speaks to them in a language they understand, they feel included and part of the process of educating their children.
- Protect for underrepresented faculty's time. In addition to finding role models, it is important to not overburden them with committee work.
- Reach out to minority faculty and make them feel part of the "team." This is also very important particularly for new faculty. However, the sense of isolation for minorities can be particularly difficult for them. In spite of all their responsibilities, the department head and dean need to make an effort to connect with minority faculty and simply ask how they are doing.

6. Federal Agencies: utilize the authority of federal agencies through grants and other resources to support opportunities to increase the presence and success of women and underrepresented groups and build a more inclusive professional culture.

The NSF should support an expansive national survey of graduate students and recent PhDs, building on the pilot survey reported here, adding queries regarding the type of university the students attended. An additional survey of faculty mentoring experiences should be supported as well.

- The NSF should carefully examine the modes and nature of the interactions between MSIs and the MRSEC-PREM partners to identify the successes and limitations of the PREM program after which steps should be taken to redress the relative imbalance of MSI-partner institutions.
- Federal agencies (NSF, DoE, DoD, etc.) should consider other possible models for supporting/providing opportunities for minority faculty research and education at MSIs other than the NSF PREM program. For example, a "Micro-PREM" program in which one MSI PI receives support one graduate student, or equivalent if the MSI does not have a relevant graduate program) to collaborate with a newly-funded single-investigator grant at a Research I university. The Micro-PREM request can be submitted as soon as the award notification is issued to the Research-I university, or within six months of the beginning of the grant. The NSF should have similar response time as with REU-supplement reports to individual investigator grants
- The NSF and DoE should establish diversity-focused post-doc programs, similar to their graduate student fellowships.
- Federal agencies should encourage and support MSI consortia/collaboration.
- Federal agencies and national laboratory leadership should ensure that MSIs are given access to government (NSF/DOE) research labs and user facilities through outreach programs, to increase the number of minority faculty whose research programs might benefit from having access to the available facilities.
- State/federal government elected officials and federal agencies should support investment in/funding for state-of-the-art teaching/research facilities for MSE at MSIs.
- Federal agencies should provide training to investigators and directors of Sponsored Research Offices at MSIs on how to be more effective in competition for funding of research centers.



Workshop participants discussing recommendations to improve workplace climate.

Action Plans

Deriving from the recommendations, the following goals and actions have been outlined:

IMMEDIATE GOAL: Identify issues and challenges that have minimized minority participation in MSE.

- a. **Action:** Conduct a national survey of MSE graduate students and recent PhDs, building on the pilot survey reported here, adding queries regarding the type of university the student attended. An additional survey of faculty mentoring experiences should be supported as well.
- b. **Action:** The NSF should carefully examine the modes and nature of the interactions between MSIs and the MRSEC-PREM partners to identify the successes and limitations of the PREM program after which steps should be taken to redress the relative imbalance of MSI-partner institution.

NEAR TERM GOAL 1: Gather and disseminate data.

- a. **Action:** Develop materials that can be used by department heads at faculty meetings.
- b. **Action:** Department heads meet with students, scientific staff, and faculty who belong to underrepresented groups and consult with them to learn more about their experiences, the challenges they face, and the suggestions they believe are needed to improve climate.

NEAR TERM GOAL 2: Launch and track initiatives to increase the number of minorities pursuing degrees and careers in MSE.

- a. **Action:** University Materials Council (UMC) encourage more participation from minority serving institutions (MSI) programs and departments.
- b. **Action:** Establish faculty mentorship training on how to mentor post-docs and graduate students. The training should include issues related to being conscious of equal treatment to all students/post-docs.
- c. **Action:** Ensure that department or college-wide events such as seminar series and sponsored conferences include presenters of various ages, genders, nationalities, races, and ethnicities.
- d. **Action:** University department heads and deans at MSIs work towards the alignment of MSI aspirations and strategic vision with the vision of federal funding agencies.
- e. **Action:** Develop and promote high standards for civil engagement with all people in the workplace.
- f. **Action:** Federal agencies consider other possible models for supporting and providing opportunities for minority faculty research and education at MSIs other than the NSF PREM program. For example, a "Micro-PREM" program in which one MSI PI receives support (e.g., one graduate student) to collaborate with a newly funded single-investigator grant at a Research I university.
- g. **Action:** The NSF and DoE should establish minority post-doc programs, similar to their graduate student fellowships.
- h. **Action:** Federal agencies encourage and support MSI consortia/collaboration.
- i. **Recommendation:** Federal agencies and national laboratory leadership ensure that MSIs are given access to government research labs and user facilities through outreach programs, with the view that the number of minority faculty whose research programs might benefit from having access to the available facilities would be increased.
- j. **Recommendation:** Provide training to investigators and directors of sponsored research offices at MSIs on how to be more effective in competition for funding of research centers.

LONG TERM GOAL: Create an ever-increasing number of minority role models in science fields who will, in turn, draw others in to contribute to the workforce of the future.

- a. **Action:** In five years, convene a follow-up conference on women and underrepresented minorities in Materials Science and Engineering

COMMONLY REFERENCED AGENCIES AND PROGRAMS BY ACRONYM

ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers

AGEP: Alliances for Graduate Education and the Professoriate

BES: Department of Energy's Basic Energy Science

CAREER: National Science Foundation's Faculty Early Career Development Program

COACHE: Collaborative on Academic Careers in Higher Education

CREST: Centers of Research Excellence in Science and Technology

DMR: NSF's Division of Materials Research

DOD: Department of Defense

DOE: Department of Energy

FACES: Facilitating Academic Careers in Engineering and Science

HBCU-UP: Historically Black Colleges and Universities Undergraduate Program

IMPACT: Increase Minority Presence within Academia through Continuous Training

MIRT: Materials Interdisciplinary Research Team

MRSEC: NSF's Materials Research Science and Engineering

MSI: Minority Serving Institutions

NSF: National Science Foundation

PECASE: Presidential Early Career Award for Scientists and Engineers

PREM: Partnership for Research and Education in Materials Science

UMC: University Materials Council

WEPAN: Women Engineering Advocates Network

Session Summaries

Session 1: Unconscious Bias & Climate Issues: Improving Department Climate by Minimizing the Influence of Unconscious Bias and Assumptions on Interpersonal Interactions

Session Organizer:

Professor Marcia Gumpertz, North Carolina State University

Speaker:

Professor Eve Fine, University of Wisconsin – Madison Women in Science and Engineering Leadership Institute (WISELI)

OVERVIEW OF PRESENTATION

Eve Fine, University of Wisconsin – Madison Women in Science and Engineering Leadership Institute (WISELI) Researcher, presented a vast and growing body of research demonstrating that people who have strong egalitarian values and believe that they are not biased may unconsciously behave in discriminatory ways. Because unconscious or implicit bias can influence our judgments and interactions with others, becoming aware of these biases and consciously striving to minimize them are important first steps towards improving department climate.

Diverse working groups are more productive, creative and innovative than homogeneous groups (Herring 2009; Page 2007; van Kneppenberg and Schippers 2007; Chang et al 2003). Dr. Fine asked the question: “Despite broad commitment to the goal of diversity, why are results less than satisfactory?”

Two factors are important components of the answer: (1) department and campus climate, and (2) the impact of unconscious bias and assumptions. Department climate is paramount because perceptions about department climate are key determinants for faculty satisfaction and retention.

Dr. Fine demonstrated that women and minority faculty experience a more challenging departmental climate and are also more likely to seriously consider leaving the university using survey results from the University of Wisconsin – Madison, but UW – Madison is typical. The survey results showed that in 2010 a lower proportion of women than men and a lower proportion of faculty of color than majority faculty rated the climate in their department as positive or very positive. Women and faculty of color reported lower levels of respect from colleagues and students and reported having to work harder to be perceived as a legitimate scholar. In the same survey, higher proportions of women and faculty of color reported that they were very or somewhat likely to leave the university in the next three years.

Unconscious bias colors all of our interactions with colleagues and students, directly contributing to the climate that women and faculty of color experience. Unconscious bias is the tendency of our minds to judge individuals by the real or imagined characteristics of the groups to which they belong. Dr. Fine presented numerous studies demonstrating that most people: men, women, people of all races and ethnicities, hold unconscious biases and rely on unconscious assumptions even though we intend to be fair and believe that we are fair. This is because the human brain works by categorizing things, allowing us to quickly and efficiently organize and retrieve information. We get tripped up though, when we relate to individuals acting on unconscious assumptions about groups. The studies demonstrate how these unconscious biases affect how we evaluate CVs, letters of recommendation, acceptance of articles for journal publication and proposals for grant funding. Faculty and students of color experience microaggressions daily that may be unintentional, but communicate lack of respect or hostility.

It is important to realize that we all have unconscious habits of mind and it is not easy to unlearn those habits. Studies have shown that it is not productive to try to suppress the bias (Liberman and Forster 2000; Macrae et al. 1994). Instead, it is important to be aware, to question your objectivity and to actively replace stereotypical responses with non-stereotypical responses. The pattern can be broken by taking time when making important judgments rather than going with first thoughts, obtaining more information, and practicing the skills of making unbiased attributions. It is also important to realize that you probably will slip up on occasion, but the effort is necessary in order to bring implicit responses into line with explicit beliefs.

The climate of the department is built from the daily interactions among its members, so it is the work of all the department members to become aware of the pernicious habits of mind that result in microaggressions and that may prevent faculty and students of color from being evaluated fairly or becoming highly valued colleagues. This work of recognizing unconscious biases, proactively valuing faculty and students of color, and replacing stereotypes with counter-stereotypes is the first step to create an environment with a high level of trust where all feel a part of the community.

Note: This article quotes heavily from the presentation “Understanding and Minimizing Unconscious Bias to Improve Department Climate” given by Eve Fine at the Workshop on Diversity in Materials Science.

REFERENCES CITED:

Chang, M.J. Witt, D. Jones, J. and Hakuta, K. 2003. *Compelling Interest: Examining the Evidence on Racial Dynamics in Colleges and Universities*. Stanford University Press, Stanford, CA.

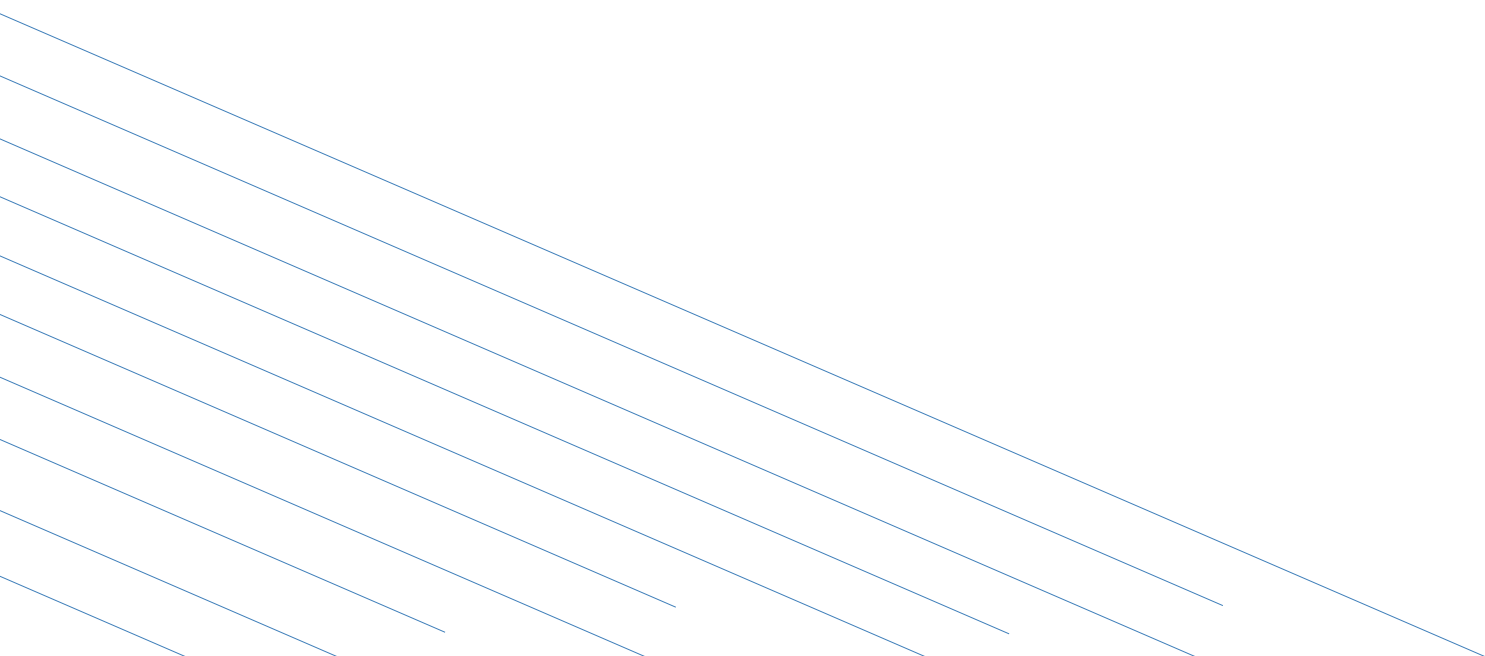
Herring, C. 2009. Does diversity pay?: Race, gender and the business case for diversity. *American Sociological Review*. 74: 208-224.

Liberman N. and Forster, J. 2000. Expression after suppression: A motivational explanation of postsuppressional rebound, *Journal of Personality and Social Psychology*. 79: 190-203.

Macrae, C.N., Bodenhausen, G.V., Milne, A.B., and Jetten, J. 1994. Out of mind but back in sight: stereotypes on the rebound. *Journal of Personality and Social Psychology*, 67:808-817.

Page, S.E. 2007. *The Difference: How the Power of Diversity Creates Better Groups, Firms, Schools, and Societies*. Princeton University Press. Princeton, NJ.

Van Knippenberg, D. and Schippers. M.C. 2007. Work group diversity. *Annual Review of Psychology*. 58: 515-541.



Session 2: Panel of Deans

Session Organizer:

Professor Justin Schwartz, North Carolina State University

Speakers:

Dean Doreen Edwards, Alfred University

Dean Enrique Lavernia, University of California Davis

Dean Darryll Pines, University of Maryland

OVERVIEW OF PRESENTATIONS

After introductions, each of the three panelists discussed their individual backgrounds and the paths they took that ultimately brought them to their current administrative positions. Each speaker is from an underrepresented group, and thus pulled from personal experiences, reflecting on how they shaped their approaches to ethnic diversity in STEM fields. While there were differences in each of their experiences, the common theme was how important it is to keep the issue of diversity at the forefront.

Dr. Pines discussed how the lack of ethnic diversity in materials science can only begin to be fixed if multiple people are not only acknowledging there is an issue, but are also actively working on addressing the problem. Dr. Pines emphasized that it is key for deans to incorporate ethnic diversity as part of strategic goals and objectives. In turn, this approach should spread from the college level to departments, etc. He provided a number of examples on how to do this, including adding underrepresented groups to search committees, even if it means going outside one's own department. Dr. Pines stressed how diversity strengthens not only departments, but entire programs, other faculty members, and as a result, the institution as a whole. Dr. Pines also incorporated examples from the earlier 'Unconscious Bias' panel session and encouraged others to make a conscious effort to change biased attitudes, particularly with regards to recruitment of students.

Dr. Lavernia emphasized the importance of establishing mentors for both undergraduate and graduate students. Based on his own personal experiences, Dr. Lavernia knows and understands that having a mentor is extremely beneficial to minority students who tend to be shy and more hesitant about reaching out. Establishing mentorships early and at the undergraduate level helps to eliminate one more barrier for minority students. Dr. Lavernia discussed the importance of taking proactive measures to retain female faculty members. He feels it is important to start early with establishing a plan to not only retain but to promote minority faculty members. Dr. Lavernia further discussed the faculty recruitment process at his current institution and the rigid guidelines that were established to ensure efforts were being made to recruit minority faculty members across campus.

Dr. Edwards encouraged faculty members to take advantage of every opportunity to teach students, in both formal and informal settings. She stressed the importance of being aware of the small messages of encouragement that one can send that can affect the outlook of students. Dr. Edwards spoke of having very few role models early on that she could relate to and how that nearly changed her path of going into higher education administration. She also addressed the topic of networking and how one's background can impact the perceived notions of what networking and connecting to others is really about. Dr. Edwards emphasized the importance of not only supporting faculty but how it is equally important for faculty members to be the role models they wished they had.



Dean Doreen Edwards, Alfred University, addresses the workshop attendees. Also seen are panelists Dean Enrique Lavernia (University of California Davis) and Dean Darryll Pines (University of Maryland), and session chair Professor Justin Schwartz (North Carolina State University).

Session 3: Issues Faced by Female Minorities

Session Organizers:

Professor Viola L. Acoff, University of Alabama
Professor Olivia Graeve, University of California San Diego

Speakers:

Dr. Nicole Campbell, Raytheon
Professor Rosario Gerhardt, Georgia Institute of Technology
Professor Olivia Graeve, University of California San Diego
Dr. Joycelyn Harrison, Air Force Office of Scientific Research



Panelists Dr. Nicole Campbell (Raytheon), Professor Rosario Gerhardt (Georgia Institute of Technology), Professor Olivia Graeve (University of California San Diego) and Dr. Joycelyn Harrison (Air Force Office of Scientific Research) discuss issues faced by female minorities.

OVERVIEW OF PRESENTATIONS

Each of the four panelists discussed some of her own experiences regarding being both a female and a minority in industry and academia and some of the challenges she has faced. The discussion topics included maintaining a work-life balance, preconceptions by others in the workplace, being a double minority, and being alienated in a male-dominated field. The panelists, who represent academia, funding agencies, and industry, varied in marital status, age, and career track and were therefore able to bring varying perspectives to the discussion as well as addressing some of the criticism they have faced and continue to face.

DISCUSSION

At the conclusion of the formal panel discussion, workshop participants were divided into four smaller groups for further discussion on topics first introduced in the presentation, with a heavy focus on maintaining work-life balance, an issue raised by the panelists. Each group was asked to not only address the issues but also to develop recommendations.

1. Children and Family/Work-Life Balance

The discussion on Children and Family and Work-Life Balance touched on faculty members, pre- and post-hire, as well as other University support staff and Postdoctoral Scholars. The following recommendations came from the discussion:

Candidate interviews

- Create and distribute brochures to family members both when a candidate is interviewing and when they start their appointment to keep the entire family involved in the process
- Provide travel grants for dependent care (Annual limit of \$800/person)
- Provide interview pay for families to travel as well; it is a family decision
- Have candidates meet with a campus resource representative to talk about work-life or other personally sensitive issues

Ongoing

- Allow faculty members to opt-out versus opt-in for tenure clock extension
- Provide faculty with a post-doc for when they are on family leave so as to keep a program going
- Allow modified duties during first year of faculty appointment
- Flex so you do not have to teach
- Rearrange your duties (college/university split the cost)
- Federal government provide modified duties pay (e.g. no-cost extension, other means)
- Provide day care near campus
- Acknowledge that work-life issues also exist for students
- Not only a women's issue

2. Work-Life Balance

Preconceptions of people in the work place do not only cause tension, but also cause minority faculty to question whether or not they should offer their contributions. The following recommendations came from the discussion:

- Set an environment that causes the broader workplace culture to go more out of the way (than normal) to listen to/hear/ask for input from minority members
- Teach ethics and sympathy for minority perspectives through instructive role-playing (i.e. helping students to understand their potential biases to counteract them)

The discussion also identified some specific problems, along with proposed solutions.

PROBLEM 1: When women raise ideas, concerns, or questions they are perceived as being overly sensitive and their voices are sometimes blatantly ignored and disregarded.

Solutions:

- Have an advocate in your department
- Use your support system outside of the department; find personal support to share personal experiences; discuss the experience with men and get their feedback about the communication, interaction and body language between men and women
- Provide micro-teaching opportunities
 - i. This should start in the classroom and be carried on throughout the college to the dean level
 - ii. Help people to recognize their biases
 - iii. People should be specifically asked to carry out actions
 - iv. IAT self-awareness test; people can complete in private
- Leaders should draw people out, encourage, and ask minorities for their opinions and to share their thoughts, e.g., having a round robin at the end of a meeting to give each person the opportunity to share their thoughts.

PROBLEM 2: A perception that minorities are approached more frequently to champion events related to diversity issues, leading to committee overload.

- Be mindful of how this could affect their careers

3. Being a Double Minority

This discussion focused on being both a female and a person from an underrepresented group. The following recommendations came from the discussion:

- Communicate (awareness) - Actually address the topic
- Men should acknowledge the problems/issues double minorities face
- Mentor across race and gender (i.e., white male/minority female)
- Address the stereotype of the double minority as being outspoken, trouble makers, abrasive
- Understand the younger double minorities' current issues and how mentors can help
- Raise awareness that having double minorities in positions of power to actually affect the community
- Do not tiptoe around the topic and be honest; ask questions
- Specialize in an area if you are passionate about something. One must make the choice to dedicate.
- Be aware of double minority problems/needs
 - i. Grad student maternity (paternity) leave
 - ii. Incapacitation (disability leave)

PROBLEM 3: Alienation in a Male-Dominated Field poses many problems and can affect not only entire departments but an institution as well.

- Require diversity education – it works
- Support from highest level of management.
 - iii. Invite people to lunch
 - iv. Inclusiveness
- Avoid being an inadvertent facilitator.
- Create a mentoring program.

An important topic that was brought up during the discussion portion was helping to establish and maintain a work-life balance for students because they are the next generation of faculty. Many questions were raised concerning family leave options for graduate students and it was agreed that this is a critical topic that must have further in-depth discussions.

Session 4: Role and Needs of Minority Serving Institutions

Session Organizers:

Professor Frank Hunte and Professor Ramón Collazo

PART 1: ROLE OF THE FEDERAL AGENCIES

Speakers:

Dr. Linda Horton, Director Materials Sciences and Engineering Division, DOE-BES

Dr. Sean Jones, Program Director, MRSECs, MIRTs, and PREM

Dr. Claudia Rankins, Program Officer for HBCU-UP and CREST

OVERVIEW OF PRESENTATIONS

Each speaker discussed the current programs their agency supports with an emphasis on the initial impact of the programs to minority participants and minority serving institutions (MSIs). This portion of the session primarily provided information on the programs available to MSIs as well as the current enrollment and funding of such programs.

Dr. Horton provided statistics of DOE-BES funding including the percentage of minorities funded. She also emphasized the early career awards that are available from the DOE for new faculty members as well as programs encouraging collaborations between individual principal investigators and DOE-funded research facilities. Of particular relevance to the topic at hand is that, when asked, Dr. Horton stated that there are no special set-asides for minorities or MSIs within DOE-BES funding.

Dr. Sean Jones discussed the influence of NSF's Materials Research Science and Engineering (MRSEC), Materials Interdisciplinary Research Team (MIRT) and Partnership for Research and Education in Materials Science (PREM) programs on long-term matriculation of minorities in materials science and engineering. Dr. Jones emphasized the impact of the PREM program, which funds collaborative efforts between MSIs and research groups supported by the NSF's Division of Materials Research (DMR), on participating students and the decision of a large percentage of these students to continue in STEM fields. Many students involved in the PREM programs as undergraduates enrolled in MSIs (and through REU programs) continued their graduate studies with the collaborating non-MSI university. Dr. Jones also discussed community college participation in the programs and it was implied that community college students are an untapped resource for promoting diversity in STEM fields.

Dr. Claudia Rankins' presentation on the Historically Black Colleges and Universities Undergraduate Program (HBCU-UP) and its role within the Centers of Research Excellence in Science and Technology (CREST), served as a more specific example of the NSF programs available for minority undergraduate students. The HBCU-UP program focuses on improving STEM education in HBCU undergrad programs and through collaboration with CREST STEM research is introduced to HBCU students early in their academic careers.

DISCUSSION

This session primarily provided information to the attendees about available programs targeted to encourage research in MSIs and the accompanying statistics involving student matriculation beyond undergraduate degrees.

Some important points raised during question and answer/comment sessions following the presenters included:

- PREM/CREST opportunities are under-utilized
- Large funding agencies such as DOE-BES are not putting special set-asides for minorities
- Attendees of MSIs are benefiting from the programs as undergrads, however there is a disconnect between undergrad and grad preparation
- The PREM and CREST programs played a crucial role in the development of research programs and the research environment at MSIs (example being Tuskegee University an HBCU involved in the PREM program).



Dr. Claudia Rankins discusses NSF programs that address the needs of minority institutions.

An important topic that was not addressed by the speakers was the implementation of target goals, i.e. what is the number of minority undergraduates, graduate students, university faculty, etc. that will represent the achievement of the overarching goal of these programs? Considering the statistics provided by all speakers describing an increase in minority participation due to these established programs, it may be possible to define funding criteria that would achieve these goals in a finite time frame. If this suggested financial contribution did not reach the projected goal, perhaps it would be necessary for federal agencies to take additional or alternative approaches to encourage minority participation in STEM fields. Overall this portion of the session emphasized the importance of federal agencies in providing a foundation for collaborative efforts between MSIs and prominent research universities as well as the impact of REU programs on matriculation of minority students in STEM programs.

Based on the discussion points above, some suggested actionable items are:

- Additional campaigns to raise awareness about the availability of these federal programs
- Setting of target goals by these federal programs as well as possible set-asides for minority principal investigators
- Additional outreach to MSIs and community colleges notifying students of the ability to be financially supported during their graduate careers

PART 2: PANEL DISCUSSION ON MSI PERSPECTIVES ON THE ROLE AND NEEDS OF MINORITY SERVING INSTITUTIONS

Panelists:

Professor Lamartine Meda, Department of Chemistry & PREM Director, Xavier University

Dr. Mark Melton, Dean of the School of Sciences, Mathematics, and Engineering, St. Augustine's College

Professor Gerardo Morell, University of Puerto Rico-Rio Piedras

Professor Oswald Uwakweh, University of Puerto Rico-Mayagüez

OVERVIEW OF PRESENTATIONS

Panel participants discussed their own experiences as minorities in STEM fields as well as the roles they have individually played to encourage minority participation and advancement at their respective MSI, before being asked questions by the audience. There was a larger variation of discussion points in the panel as compared to the previous session and considerable overlap in experience by individual panelists. Panelists' talking points will be included in the discussion section.

DISCUSSION

All panelists stressed the importance of federal agency funding programs, and specifically PREM, in supporting their respective MSIs. Concerning undergraduate and graduate education, emphasis was placed on the need to better prepare MSI students for graduate and faculty environments outside of their university. The preparation for students and new faculty depends on both academic preparation for students (as STEM Grade Point Averages and GRE scores at MSIs were suggested to be on average lower than those required for admission to top-notch, non-MSI research universities) and the awareness of a climate difference between MSIs and non-MSIs. In the case of the University of Puerto Rico, for example, and likely applicable to other Hispanic MSIs, the necessity of a bilingual or an English speaking environment is suggested for those students who may wish to attend mainland universities, as well as the need of faculty at UPR to be prepared for a non-English speaking student body.

An important discussion point brought up by a member of the panel is the discouragement of universities to hire alumni. Some important questions to consider regarding this point:

Could discouraging alumni hires have a larger impact on minority faculty hires?

- If the majority of minority students receive STEM degrees at MSIs, how can a MSI department have minority faculty and what influence does this have on MSI climate (especially in STEM fields)?
- Additional discussion regarding faculty included the importance of department chairs to make themselves available for new faculty members and to support new faculty members as they learn to write grant proposals (and face ultimate initial rejection).

Two additional questions were asked of the MSI panelists:

1. What is the niche for the MSIs? . . . undergraduate to PhD, PhD and beyond or something/what else?

Response: MSIs have a significant role to play in the solution to increasing the numbers of minority faculty in MSE that goes beyond merely providing graduate students for the pipeline to Research I universities. Though lacking the infrastructure that exists at the larger universities, the MSIs are the natural setting where the comfort level derived from the climate for minorities is a major contributing factor to success. A possible role for the MSIs could be service as incubators for minority faculty training and development. Faculty exchange programs between Research I universities and the MSIs in the form of sabbaticals could be a way to accomplish this objective.

2. Are the Sponsored Research Offices at MSIs adequately staffed to provide the kind of support that increasingly competitive funding demands?

Response: MSIs typically operate on significantly smaller budgets than Research I universities with large endowments and therefore the Sponsored Research Offices at MSIs would not be able to attract the same number of people with the level of experience in grant writing and proposal support necessary to be competitive for funding.



Session 5: IMPACT Program Overview

Session Organizer:

Professor Justin Schwartz, North Carolina State University

Speaker:

Professor Rosario Gerhardt, Georgia Institute of Technology

INTRODUCTION

IMPACT is an acronym for a proposed initiative that aims to Increase Minority Presence within Academia through Continuous Training and with particular emphasis upon the engineering disciplines. It is being spearheaded by the Georgia Institute of Technology and will extend the successes of the preceding National Science Foundation project FACES (Facilitating Academic Careers in Engineering and Science). FACES was a collaborative alliance between Georgia Tech, Emory, Morehouse and Spelman that utilized programmatic activities designed to assist underrepresented engineering and science students with navigating the path of completing the terminal degree and entering academic careers.

FACES: A PROVEN PRECEDENT

The two phases of FACES will have spanned fifteen years at the end of its NSF support in 2013, at a total value of \$13.7 million (including cost share). FACES coincided with a nearly 43% increase in Georgia Tech's enrollment of underrepresented minorities (URMs) in graduate engineering and science programs (i.e., from approximately 175 to 250 between 1998 and 2010, as reported in the 2011 NSF Joint Annual Meeting FACES poster). The FACES alliance directly aided in the retention of over 160 URM science and engineering fellows; and there was a positive impact on the number of Ph.D. degrees awarded to URMs (383) during this period, as well as their incorporation into the engineering professoriate. Examples of such impact are that over thirty (and counting) beneficiaries of the FACES initiative have entered the tenure track professoriate, with ten having been awarded prestigious young investigator awards from various agencies (i.e., National Science Foundation PECASE and/or CAREER, National Institutes of Health, Air Force Office of Scientific Research). Three of the ten awardees were PECASE recipients.

The range of immersive activities used to encourage and assist entry into the STEM professoriate included:

- **Periodic enrichment seminars:** FACES participants were provided monthly enrichment seminars throughout their academic years. A variety of topics promoted, and prepared them for the professoriate, including traditional considerations such as faculty interviewing; retention, tenure and promotion; and integrating research and education. Lesser known benefits or considerations of academia were also conveyed, such as innovation and intellectual property development under university sanctioning, and managing the simultaneous emergence of a young family and a young academic career. Contributors to these seminars were often faculty members from underrepresented groups, and several of these faculty members also served on the FACES AGEP Steering Committee. Surveys consistently indicated student appreciation for the exposure.
- **Mentoring:** Georgia Tech FACES participants received mentoring from URM Georgia Tech faculty members that were typically within the same disciplines. This was often done in informal settings, such as periodic mentor-mentees lunches on campus or social gatherings associated with FACES. This approach was beneficial in multiple ways. The mentees were encouraged and exhorted to continue through their doctoral program milestone points by "objective counsel," given that the FACES mentors were typically not a part of the students' committees; and there were natural motivations for mentees to "see themselves" as future faculty given the conversations with faculty of similar demographic backgrounds. The mentors were given opportunities to bond with prospective future faculty, share their "lessons learned" and be reminded of the social impact that their academic positions afford them.
- **Teaching Practica:** Selected FACES participants were given the opportunity to participate in teaching practica, wherein they were exposed to all aspects of teaching a course under the supervision and mentorship of the course's responsible professor. These co-instructions of classes involved potential syllabus development, lecture preparation and delivery, tests and assignments formation and evaluation, and other core instructional activities.

- **Early academic career “start-up” support:** The FACES program provided \$30,000 Career Initiation Grants (CIGs) to new and recent URM doctoral graduate students of the alliance that accepted tenure track faculty positions in engineering or science at a U.S. college or university. Alternatively, the Portable Post-Doc Program provided stipends of \$35,000 to talented Ph.D. engineering or science graduates from the alliance that served as one-year post-doctoral fellowships. These also assisted in developing follow-on academic paths. Both funding mechanisms were novel incentives and catalysts for a “newly minted” Ph.D. to have expedited success in academia.

A statistical study of the effectiveness of these enrichment activities for FACES fellows was performed in comparison to other control groups of STEM doctoral graduates from Georgia Tech. Analysis of variance results indicated that FACES participants expressed higher levels of preparation compared to non-URM STEM alumni in teaching a college level course in their respective disciplines, giving job talks, thinking critically and logically, understanding professional and ethical responsibilities, engaging in lifelong learning, and exercising leadership skills. In addition, FACES alumni were nearly twice as likely to be in an academic field compared with URM graduates without the FACES experience.

IMPACT: PROPAGATING THE BENEFIT

Despite the successes experienced in the FACES program, there remains a larger-scale need to provide a multi-faceted training construct that motivates and equips underrepresented minorities (URMs) toward service in engineering academia. The proposed IMPACT initiative endeavors to achieve this end by systematically immersing a regional cohort (or “community-of-interest”) of engineering graduate students and postdoctoral associates within a proven model of continuous training. Such training will be done by a critical mass of role models from within the same region. Engagement would be frequent via a blend of telecommunications media (e.g., video teleconferencing and online interactive trainings) and in-person settings (e.g., mutual attendance at regional and national meetings of URM engineering societies and complementary events such as the Southern Regional Education Board Compact Institute). Regarding dissemination, best practices will continue to be provided to engineering educational leaders at their respective administrators meetings. Conference-journal publications will also continue. Finally, the “impact of IMPACT” will be tracked via periodic evaluations of the improvement of participating universities’ retention of URM engineering graduate students, participants’ evolving impressions of academia, and their career choices.

Session 6: Retention, Mentoring and Success

Session Organizer:

Professor Rudy Buchheit, Ohio State University

Speakers:

Associate Dean Christine Grant, North Carolina State University

Professor Joan Herbers, Ohio State University

The challenges of academic leadership require attention to retention, mentoring and success. This attention should be followed up by active commitment to career-building academic initiatives that engage a diverse set of STEM experts in the academy. The NSF-supported efforts to diversify the academic ranks of Materials Science and Engineering (MSE) are a critical component of this process of identifying the key challenges and suggesting future opportunities for change.



Recruiting diverse MSE faculty members is challenging. The mentoring of these same faculties often makes one wonder, "Am I really doing enough?" Finally, the retention and successful career progression of diverse faculty can cause one to ask the question, "What is the cost of academic bliss?" This question is asked by current and potential faculty throughout the academy and is crucially important to faculty who make the academy diverse. While one could argue about the existence of "academic bliss," certainly the attainment of balance and a general sense of faculty well-being is important for all faculty.

Underrepresented minority graduate students, post-doctoral associates and faculty are often the "only-lonely" in their MSE departments, perhaps the trailblazers and the firsts in their particular institution's materials science and engineering programs. The potential friction and eventual wearing down of the resolve of this group can occur with or without the knowledge of the rest of the materials science and engineering faculty, students and staff. It is at that point that URM academics may leave the institution in which they were recruited to spend a component of their academic career. At times it is too late to salvage the already worn down aspects of the sense of "belonging," to build up true and authentic connections in the research realm and to facilitate the engagement of these academics as true colleagues.

Using a materials science analogy, friction and wear are an important part of materials use and degradation. We know that friction is a non-equilibrium process. Friction and wear are irreversible processes which normally lead to material deterioration. Under certain circumstances, friction can lead to self-organization or increased orderliness. There are also various "secondary structures" that can be formed at the frictional interface. Starting with this description, if we take as the framework the concept of self-healing, self-lubricating and self-cleaning in what can be a very physically intense process during friction and wear, we can project what should happen during the retention and success of diverse faculty.

To recruit, retain and promote URM academics in MSE, we need processes, resources and collaborations that are sustainable and that work. In the areas of recruiting, mentoring, retention and the anticipated successes, it is critical to "un-understand, re-understand and then act!"

While we all, including deans, may select this academic job for the same reasons, the experiences of URM faculty are often vastly different from their majority colleagues. So, in addition to grant-seeking, student teaching and committee meetings, they often have other subtle things that happen to them in the course of their experience as faculty members. Ultimately, there is a need to identify talented engineering faculty from minority groups to be recruited into leadership positions within colleges of engineering. It is an important long-term goal that should be set in parallel with the successful upward movement of URM materials science faculty in the academy.

In a recent webinar sponsored by WEPAN (Women Engineering Advocates Network) entitled, "Forging Faculty Alliances in Academia: White Women/Men and Women of Color in Dialogue" presented in 2012, David Leonard and Christine Grant convened "A Dialogue on the Barriers and Bridges to Success for Women of Color STEM Faculty".² While the original focus was on Women of Color, there are key aspects that are similar to the issues facing URM faculty across the STEM fields. There were several components of that dialogue that are relevant in a discussion on diversity in materials science programs. In the area of Materials Science, the issues are complicated by the fact that there are several cross-disciplinary research programs in which students/post docs and faculty may be trained in a specific

² WEPAN Webinar "Forging Faculty Alliances in Academia: White Women/Men and Women of Color in Dialogue The Allies and Partners Project" <http://archive.constantcontact.com/fs160/1103000146788/archive/111123355633.html> (2012)

discipline (e.g., physics) and pursue a graduate degree, post doc or faculty position in a materials science and engineering department. In this case, the nuances associated with the discipline and the culture of the core discipline in which they were trained may require a different set of mentors or advisors for a successful career. Specific issues to consider include:

What are barriers in the academy for URM/faculty of color?

- Resource allocation: inequities and additional required “self-advocacy”
- Honest and authentic professional engagement with peers and leadership
- Assumptions on “right” type and level of engagement
- Heavy service requirement
- Lack of mentors, advocates, champions (cross-cultural, etc.)
- Few senior level faculty and administrators of color
- Assumed to be a resource for all things diverse
- Being perceived as a “data point” for faculty of color initiatives and studies
- Perceived notions of potential for success

What are experiences of “the only” faculty of color in a department (in a college, or in an institution)?

- Getting “colorful” service requests
- Perception they are getting “special” treatment
- Protecting vs. Mentoring vs. Coddling (this is not always handled properly)
- “Unspoken/Spoken” murmurings of faculty & students
- Casualty of unique blend of university politics
- Lack of inclusion in discussions relevant to their own career development
- Not seen as valid/ bona fide /serious “players” in the academy
- Isolated from “normal” academic support system
- Lack of true allies

Often it is the little or blatantly insensitive things that people in leadership and senior colleagues do or say that erode the positive perspective that a faculty member has on the academy or that particular institution.

What are ways that majority colleagues can partner with faculty of color to help alleviate negative climate experiences?

Do!

- Remember core areas of academic commonality. We all started in the academy for the same reasons: to perform research, train students and impact society
- Have authentic conversations with the intent of growth
- Identify mechanisms to train faculty/leadership based on “data” (e.g., COACHE climate studies)
- Provide and facilitate access to networks for success
- Understand white privilege, power constructs, unconscious bias
- Talk to faculty of color in your professional discipline (e.g., at national conferences)
- Invite faculty of color for scholarly discipline seminars at your institution; have side conversations on diversity as appropriate
- Empower, Engage and Exchange
- Read “Unlikely Allies in the Academy: Women of Color and White Women in Conversation” and connect with author Karen Dace

Do not!

- Demonstrate lukewarm support and form fake alliances
- Attempt to study URM faculty solely as data points in an academic experiment

What are the critical issues in the mentoring and retention of URM faculty?

- Different types of mentoring occur in the academy. There are not enough URM faculty to mentor each other.
- Cross cultural mentoring is critical
- Absence of – or shabby mentoring causes people to leave
- Retention is a critical component of the academy for URM faculty.
- Is moving faculty around from one school to another really progress if the overall numbers remain the same?
- Administrators are often clueless on the reasons for URM faculty leaving.
- A person leaving... and the subsequent hirem – DO NOT solve the problem at your institution...

In summary, while spontaneous “self-healing, self-lubricating and self-cleaning” can occur, the intentional addition of a solid or liquid lubricant can address friction and wear issues. Similarly, the attainment of true ethnic diversity with authentic collaboration and engagement in MSE will require different approaches, initiatives and programming to “lubricate” the process. A number of these are in existence and have been the result of NSF broadening participation programs such as ADVANCE, AGEP and HBCU-UP. But just like the design of novel lubricants, the true success will come from the design of innovative approaches that actively engage diverse senior engineering faculty. This will ensure the development of culturally diverse and relevant approaches that understand the academic culture that exists in MSE. It is the collective committed and authentic engagement of academic leadership that will ensure success.



Session 7: Results from Graduate Student Survey

Session Organizer:

Professor Marcia Gumpertz, North Carolina State University

Speaker:

Dr. Rebecca Brent, President of Education Designs, Inc.

BACKGROUND

A survey was conducted in advance of the workshop to assess the circumstances surrounding the troubling lack of ethnic and gender diversity in materials science and engineering all along the pipeline from undergraduates to faculty members. Two surveys aimed at understanding some of the root causes within the graduate school experience of MSE students were performed; results were presented at the workshop. Topics of particular interest were the nature and quality of the students' career preparation and mentoring experiences, including being given career guidance and introductions to their professional community by their advisor, and having opportunities to present their research and teach. Information was also gathered on what attracted students to materials science and engineering and their future career plans. Thus, the two surveys were sent to current graduate students and recent graduates. (See Appendices B and C).

METHODOLOGY

The workshop organizers secured email lists of graduate students and recent graduates from two public institutions and a private institution that agreed to forward a survey link to their current graduate students. The surveys were administered using a professional account at SurveyMonkey, a web survey development cloud. Graduate students and recent graduates at the three participating institutions were invited to participate, after which they were sent a message with a link to the survey. The survey was open for about two weeks and a reminder message was sent shortly before it closed. The response rates are shown in Table 1.

Table 1: Survey Response Rate

	Surveys Sent	Respondents	Response Rate
Current MSE graduate students	457	117	21.4%
Recent MSE graduate alumni	315	47	14.9%

Graduate Student Responses

Figures 1 and 2 give the percentages of respondents in several demographic categories. Of the respondents, 8.4% were working on Master's degrees with thesis, 9.3% on Master's degrees without thesis, and 82.2% on doctorates. The average number of years completed in their programs was 1.6

FIGURE 1: GENDER OF SURVEY RESPONDENTS (CURRENT STUDENTS)

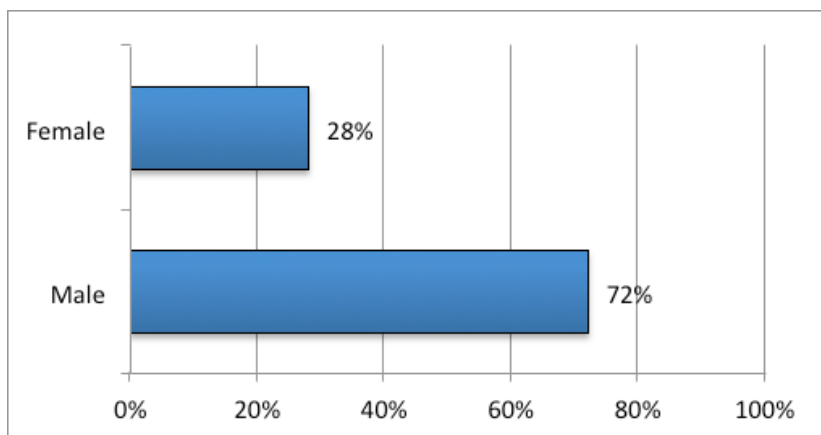
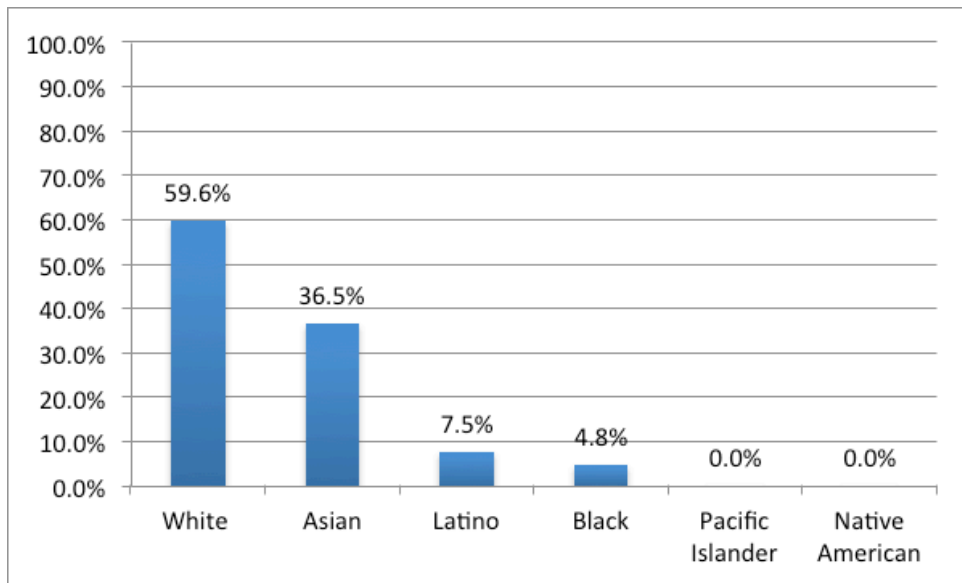


FIGURE 2: RACE AND ETHNICITY OF CURRENT GRADUATE SURVEY RESPONDENTS



The percentages in Figure 2 add up to more than 100% because respondents could select all responses that applied. To explore differences in underrepresented student populations, the survey respondents were divided into three groups: White (43), Asian (30), and a combined group of Blacks/African-Americans (5) and Latinos (8). Since Masters candidates would not generally encounter the full range of experiences being investigated, only doctoral students were included in this part of the analysis. The number of responses in this pilot survey (particularly from underrepresented populations) was insufficient to test observed differences for statistical significance.

Table 2 shows the percentages of respondents who reported receiving each of 11 career preparation experiences. For most of the experiences (those shown in boldface), the percentages increased the longer the students were in their programs. Almost all students in the first years of their program reported receiving guidance in conducting research. Once they completed Year 4, fewer reported receiving any such guidance, presumably because they had progressed to a more independent stage of their work.

Table 2: Mentoring experiences by completed years in program

	<2 yrs N=46	2-3 yrs N=26	4+ yrs N=14
Receiving guidance in conducting research	93.5%	92.3%	78.6%
Presenting my research at seminars at my university	15.2%	57.7%	21.4%
Presenting my research at a regional or national conference	15.2%	84.6%	85.7%
Authoring or co-authoring a paper on my research	21.7%	57.7%	85.7%
Introduced by advisor to experts in my field	17.4%	50.0%	71.4%
Covering one or more class or recitation sessions	19.6%	50.0%	50.0%
Teaching a lecture/recitation section	10.9%	30.8%	57.1%
Take a workshop or course on teaching	4.3%	23.1%	42.9%
Opportunity to mentor an undergraduate	28.3%	61.6%	71.9%
Receiving career advice from my advisor	43.5%	69.2%	71.4%
Receiving personal advice from my advisor	34.8%	61.5%	50.0%

Reported frequencies of the experiences varied for the different racial and ethnic groups (Table 3). Relatively more white than Latino/black students had the first nine experiences listed in the table and the opposite result was obtained for the last two experiences (covering class or recitation sessions and mentoring undergraduates). No clear pattern of differences between white and Asian students was observed.

Table 3: Mentoring experiences by race/ethnic group

	White N=43	Asian N=30	Latino/Black N=13
Introduced by advisor to experts in my field	46.5%	27.6%	15.4%
Presenting my research at a regional or national conference	53.5%	44.8%	30.8%
Presenting my research at seminars at my university	37.2%	20.7%	15.4%
Authoring or co-authoring a paper on my research	37.2%	58.6%	23.1%
Receiving guidance in conducting research	95.3%	82.8%	84.6%
Receiving personal advice from my advisor	48.8%	41.4%	38.5%
Receiving career advice from my advisor	62.8%	44.8%	53.8%
Take a workshop or course on teaching	16.3%	20.7%	7.7%
Teaching a lecture/recitation section	18.6%	37.9%	15.4%
Covering one or more class or recitation sessions	32.6%	34.5%	38.5%
Opportunity to mentor an undergraduate	46.6%	34.5%	69.2%

Other findings were that Latino/black students:

- were less likely than white students to be encouraged to enter MSE by high school counselors (W 14%, L/B 0%) and family (W 47%, L/B 10%).
- were more likely than white students to be encouraged to enter MSE by undergraduate advisors (W 36%, L/B 50%) and fellow students (W 40%, L/B 31%).
- were less likely than white students to plan for an academic career (W 40%, L/B 31%). When asked if they would like to work in academia, larger percentages of both groups responded positively (W 59%, L/B 54%).

Alumni Responses

Figures 3 and 4 give the percentages of recent graduates in a number of demographic categories. Just as with the current graduate students, there were very few Latinos and African-Americans, and no Native Americans or Pacific Islanders. Seventy-seven percent of the respondents were male.

FIGURE 3: GENDER OF SURVEY RESPONDENTS (RECENT GRADUATES)

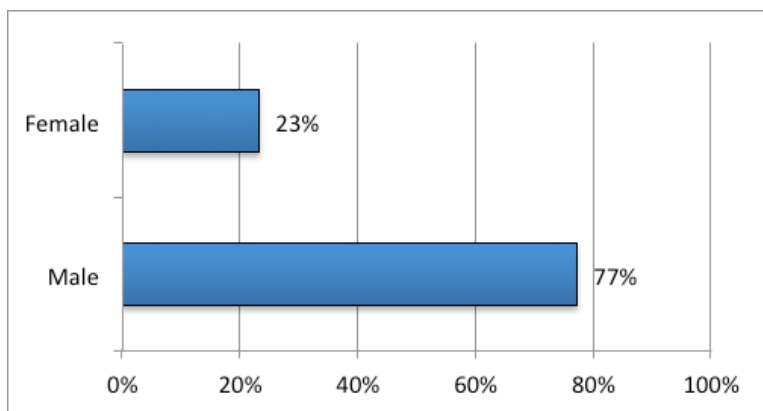
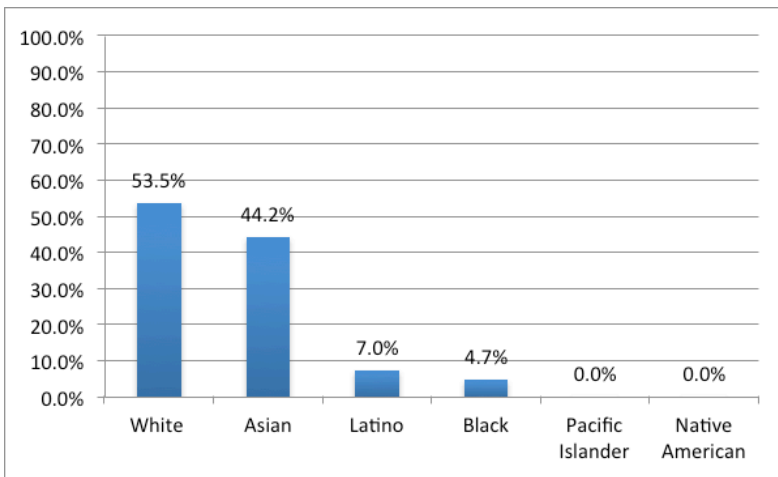
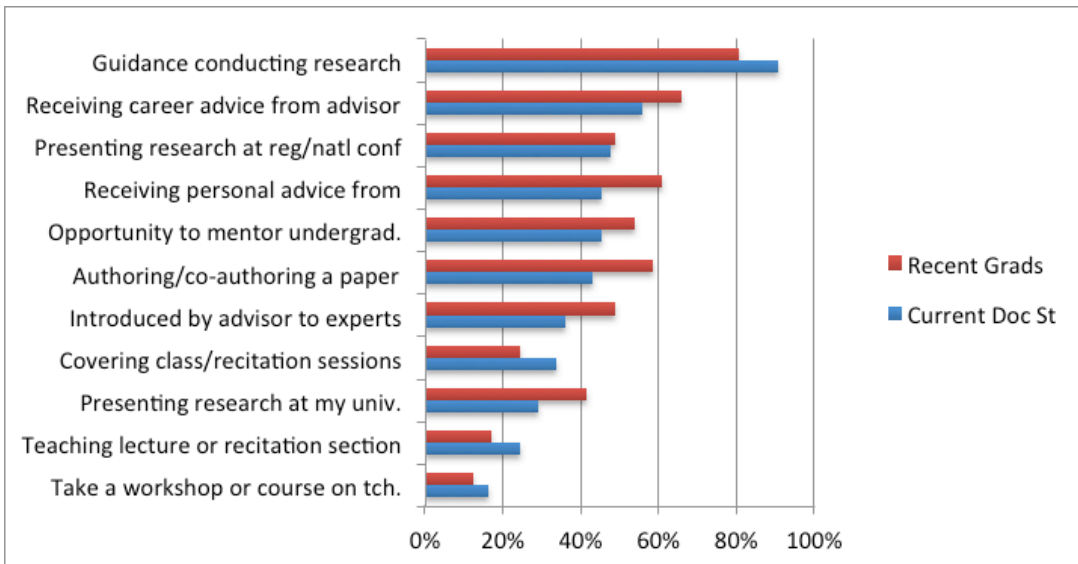


FIGURE 4: RACE AND ETHNICITY OF SURVEY RESPONDENTS (RECENT GRADUATES)



The career preparation experiences of the recent graduates were roughly comparable to those of the current doctoral students (Figure 5).

FIGURE 5: EXPERIENCES OF ALUMNI AND CURRENT DOCTORAL STUDENTS



There were not enough responses in the Latino/Black categories to break out the alumni results by ethnic/racial category.

IMPLICATIONS AND POTENTIAL ACTION ITEMS

The two surveys reported here provide interesting insights into the experiences of MSE graduate students. It would be premature to base policy decisions on a small sample pilot study; replication of the findings in a larger study would suggest several measures to increase the quality of career preparation and mentoring for MSE graduate students:

- Since non-white students, especially Latino and Black students, generally report having fewer career preparation experiences, graduate advisors should be encouraged to be sure that all students receive as many appropriate experiences as possible. Sessions might be provided at national and regional MSE conferences to inform advisors of strategies they can use to better mentor all students. The strategies might be included in MSE publications to reach a wider audience.
- MSE graduate programs might look at the list of mentoring experiences and seek to provide some of the experiences for their students. A relatively small percentage of students, for example, reported having the opportunity to present their research in their own department or college. A department might decide to structure such opportunities.

- To encourage students to consider academic careers and to equip them to be successful, more opportunities could be provided for graduate students to cover classes, teach problem sessions and recitations, and learn about teaching through workshops and seminars.
- A relatively simple action any graduate MSE program could take is to provide seminars or workshops on preparing for an academic career.
- Steps might also be taken to encourage a more diverse group of students to enter MSE:
- Latino and Black students reported being more heavily influenced by their undergraduate advisors and fellow students than by high school counselors and family members. MSE departments might offer programs at which first- and second-year students can become acquainted with the field and talk with more advanced students and alumni. The same strategy might be used to encourage undergraduates in related fields to undertake graduate study in MSE.
- Only 14% of all students were encouraged by their high school counselors to enter MSE. Improving outreach by MSE programs to counselors could potentially have a significant effect on recruitment efforts.

NATIONAL SURVEY

The survey reported here was a pilot study to explore issues affecting the recruitment and diversity of MSE graduate students. The results clearly suggest differences in the experiences of different groups of students. What is needed now is a larger national study that would sample enough students from underrepresented populations in MSE (e.g., Latinos and Black students) to test observed differences for statistical significance. A successful study of that nature should serve as a model for other STEM disciplines with similar challenges.

Sampling. The study should draw from programs across the nation and across different types of institutions, including an expansion into community colleges. The UMC can assist in assembling a sample. A stratified random sample should be constructed to oversample underrepresented groups and assure good representation of students at all levels in their graduate programs.

Survey. Most items in the survey covered in this report functioned as intended, with open comments suggesting additional items that should be included. The survey should be revised to include those items as well as a few more open-ended questions to clarify the experiences of students.

Focus groups/interviews. Many of the concerns raised by the survey (e.g., varied motivations for entering MSE and different levels of involvement in career preparation experiences for white students and racial and ethnic minorities) could be explored more thoroughly by conducting small student focus groups or structured interviews. Ideally, such interviews could be conducted at national conferences that attract a large number of MSE graduate students. Protocols for interviews or focus groups should be developed in detail, working with the UMC and other stakeholders.

Deliverables and dissemination. If these plans were carried out, the principal deliverable would be a detailed report with thorough analysis of the data. A report that just sits on a shelf, however, is not worth the effort, so the results will need to be widely disseminated if they are to have an impact. Dissemination should include:

- Posting of the report on a publicly available website frequented by MSE faculty and other professionals;
- Sessions and papers at MSE conferences devoted to reporting the findings;
- Journal articles in MSE publications;
- One-page flyers that crystallize the most relevant findings and action items distributed widely at MSE conferences and in department mailings, including strategies for attracting diverse students to MSE, effectively mentoring MSE graduate students, and preparing a diverse group of MSE graduate students for academic careers;
- Encouraging and enabling other STEM disciplines to replicate the survey design, deployment, and data analysis.
- Presentation at a TMS Diversity Summit and at the fall and spring MRS meetings.

Session 8: Perspectives of Graduate Students, Post-Docs, Young Faculty and Young Professionals

Session Organizers:

Professor Javier Garay, University of California Riverside
Dr. Sasha Ishmael, North Carolina State University

Panelists:

Milena Bobea, Doctoral Candidate, North Carolina State University
David Estrada, Doctoral Candidate, University of Illinois Urbana-Champaign
Dr. C. Scott Nordahl, Sr. Principal Engineer, Raytheon IDS

OVERVIEW OF PANEL SESSION

Three panelists were invited to discuss their background, aspirations, and experiences. After each panelist spoke, the audience was invited to ask questions. Below are some common themes that arose in the panel discussion. Some hurdles to successes that were voiced by the panel included language barriers, need for awareness, insufficient advocates and proactive mentors for increasing diversity, need for more sponsored programs, and grants.



Dr. C. Scott Nordahl (Raytheon), David Estrada (Doctoral candidate, University of Illinois Urbana-Champaign) and Milena Bobea (Doctoral candidate, North Carolina State University) provide perspectives of younger scientists.

This panel discussion brought out the following needs for students and young faculty:

1. Awareness

Of programs and fellowships that exist:

- Encourage institutions offering MSE degrees to maintain a database of Minority Based Scholarships and Fellowships. Departments should ensure this information is readily available on the departmental website. Many institutions, e.g. the Graduate College at Illinois, maintain searchable databases of fellowships, but these do not always include smaller awards at the regional level. (<https://www.grad.illinois.edu/fellowship/>)

Of issues diverse individuals face:

- Acknowledge the need for mentors, proactively teach and cultivate a mindful environment

2. Advocacy

- Aggressively promote and support at all levels an atmosphere of zero-tolerance of discrimination from department heads and deans.
- Give special attention to cases where discrimination may not be obvious, e.g. where the work environment is hostile and where unconscious biases are recognized.
- Take constructive action by deans and department heads to help people recognize perceived biases, and provide guidance to help them address them.

3. Recruitment, inclusion and integration

- Schedule additional workshops or group activities where experiences can be shared
- Work with Federal TRIO programs to identify, recruit, and retain STEM/MSE students and/or to provide academic services for these students. Federal TRIO programs include Upward Bound, Student Support Services, and the Ronald E. McNair Postbaccalaureate Programs. A list of universities having McNair programs that could be beneficial in recruiting students to enter graduate MSE programs is attached.
- Encourage institutions offering MSE degrees to provide application fee waivers and GRE support for undergraduate students applying to their graduate MSE programs, including support for their students applying to graduate programs at partner institutions.
- Work with the United States Department of Veterans Affairs to develop programs that transition veterans into materials-related careers and MSE degree programs.

RECOMMENDED ACTIONS:

University Deans, Department Heads, and Student Organizations:

- Take an active role in promotion of diversity inclusion activities; be visible in national societies that have diversity inclusion activities.
- Focus on improving the spread of information in opportunities for underrepresented minorities in different STEM careers, including industry and academia. Encourage and/or organize frequent seminars and informative sessions on good practices that can increase employment opportunities.
- Support attendance at the Society of Hispanic Professional Engineers, the Society for the Advancement of Chicanos and Native Americans, the National Society for Black Engineers, and the Society of Women Engineers National Conference to present research and participate in workshops. Recruiting tables should also be hosted to help with existing recruiting efforts at these conferences.
- Work with undergraduate and graduate students from professional societies to initiate hands-on periodic events to attract their peers from different disciplines into the field.
- Be active in mentoring and initiating “teaching moments.” Do not be afraid to address perceived biases you know of or hear about; recognize these opportunities for teaching and cultivating the environment where the workplace climate is free from biases.
- Student organizations sponsor monthly events where students meet for an invited talk from professors or young professionals to share their experiences and talk about available resources that exist

National laboratory leadership:

- Stay the course and continue to foster diversity inclusion
- Introduce or increase the summer internships available in material science; recruit from all disciplines of engineering (mechanical, electrical, aerospace, civil etc.)
- Sponsor financial assistance for students (particularly those from under-represented groups) to travel to conferences to present work performed at the laboratory

State/federal government elected officials:

- Know your constituents and represent your districts accordingly, do not only cater to the few with the loudest voices and deepest pockets.
- Continue to keep track of performance statistics of underrepresented minorities in science and mathematics from the time students are in high school. Continue and extensively address studies on effective teaching methods for minorities and how environment affects the learning process for minorities in the US.
- Seek and/or provide funding for mentoring programs, giving undergrads and grads the opportunity to mentor and demonstrate their skills and research capabilities

Professional societies:

- Continue to increase membership and grow annual budgets to raise awareness.
- Raise awareness of diversity issues within some professional societies. Members should take an active role in promoting the recommendations for increasing diversity and addressing the needs of diverse individuals in their societies.

Session 9: Keynote Address

Session Organizer:

Professor Justin Schwartz, North Carolina State University

Keynote Speaker:

Congresswoman Eddie Bernice Johnson

Congresswoman Johnson's keynote address on the impact of technology now and in the future drove home the message that we must invest in our youth if we hope to remain competitive in the global market. She provided the example of how Texas Instruments inspired in her that technology was going to be the future and everyone needed to be ready for what it would bring. That being the case, we are still at a critical time with a rapidly growing minority population, who have the least prompting and the least quality education in much-needed areas. It is a given that we will reach a point where we must rely on this growing minority population and as such it is critical that we begin to involve that population now.

To effectively involve the young population, we must begin with education and use that as the catalyst to move forward in the right direction. There is currently so much pressure on students to earn their college degrees in just four years that many students who start out in STEM fields, ultimately change their majors, which hurts our forward progress. The reality is that while we have the people to lead the charge, they are not prepared. Johnson stressed that everyone must be involved in this process and that our young people must have encouragement from home. We must provide the resources in both education settings and at home. We must prepare parents so they can be more actively involved which, in turn, will help foster this growth and thus forward movement. Having an established support system and guidance for the students will not only be good for the individual but for the country.

Congresswoman Johnson admitted that politics are a barrier in education but stated that it is imperative that we get everyone on board in order to facilitate forward progress. The fact that few minorities are chosen to serve on science committees is an example of one thing that needs to change and a way that we can be an example of moving with the needs of our country and not being static. Johnson stressed the need for high-tech jobs, as they keep people working. She pointed out that even criminals know enough about technology to commit their crimes, so our young people need to understand that and use their knowledge of technology to create change around them. Congresswoman Johnson concluded her address by telling the attendees that we cannot get the value of our worth until you invest in the future and investing in the future is investing in our young people.



Congresswoman Eddie Bernice Johnson (Texas 30th District) provides the keynote address to workshop attendees.

Appendices

APPENDIX A: POST-WORKSHOP FEEDBACK

Workshop attendees were sent an email after the conclusion of the workshop to solicit feedback on workshop content and take-aways. Below are the questions asked and the responses received (all responses are unedited quotes except where identifying information has been removed):

1. What are your primary “take-aways” from the Workshop?

- In spite of the fact that this issue has been under consideration for some period of time, the situation with respect to diversity in STEM in general and MSE in particular remains dire for all minority groups and will require a concerted effort by all stakeholders in order for significant progress to be achieved.
- There are a number of well-meaning individuals and organizations at all levels among the stakeholders who are aware of the issues and have a vested interest in finding solutions.
- It seems that personalized contact and interactions with students can be hugely influential in positive ways; however, such individual contact requires time and deliberate effort which are hard to solicit in our busy society.
- Bias can come in many forms, and people who do it may be unaware of it themselves.
- The workshop was very informative in bringing to light issues surrounding Faculty of Color, specifically recruitment, retention, and career development. I was most impressed by the participation of numerous Departmental Chairs and College Deans in the workshop. This emphasized not only the importance of these issues, but the dedication of administrators nationwide to discuss and address issues surrounding ethnic minorities in materials science and engineering.
- The workshop helped me to focus more clearly on the issues as they relate to the field of MSE. I've been aware of some of the issues around diversity in engineering and STEM more generally, but this workshop helped me look at the situation through the MSE lens.
- The most important aspect that I learned from the workshop is to be aware of biases and the way we classify people so that we do not mistakenly offend others.
- A main takeaway from the Workshop was the female minorities in STEM fields discussion panel. I felt their experiences were insightful and they were very candid about their experiences. Mentorship was also a huge takeaway; it is evident that finding the proper mentor helps an individual become successful.

2. What did you learn, or become aware of that you were not aware of previously? This can be what you learned about yourself or about others.

- It is one thing to hear about the question of diversity anecdotally, but seeing the actual statistics was a stark eye-opener to the gravity of the situation. Diversity means different things to different people. Though there are some points of commonality in the ways that the current circumstances regarding diversity are experienced, there are particular and subtle differences among the various groups of minorities such that by the very nature of diversity, there is no monolithic solution to the problem.
- Ethnicity bias can hurt “both sides”; for lack of better word choice.
- I became aware of the issues surrounding unconscious bias and double minorities, i.e. women of color. Many of the struggles female faculty of color face on a daily basis surprised me. For example, one workshop participant described a work environment where she felt obligated to hide her child under her desk when she had to bring them to work due to lack of child care. This was done to give her majority counterparts the impression that having a child was not affecting her productivity or dedication to the job.
- Through some feedback after my presentation of the MSE graduate student survey results, I became aware of the importance of demographic information. Someone made a suggestion (a plea, really) to collect LGBT information saying that there was so little information available. That had not really occurred to me and is a reminder that diversity encompasses many different ways that individuals self-identify. Many aspects of diversity are invisible and may be completely ignored if we're not careful. While you can't collect information on everything, it's probably worthwhile to broaden the information collected where possible.
- In one of the Q&A sessions, the question was asked “how black do you have to be to be considered a black person?” Being a person of mixed-blood, this has always been an issue for me in terms of defending my identity. This has made me wonder if I will be questioned in the future if I apply for awards or grants for Hispanics and be rejected for “lying” about my background since this has been an issue in my personal life. I was able to talk with many people at the workshop who have dealt with similar issues to this, as well as to NSF employees. This allowed me to realize that this is not an issue I should dwell on, and that I do not need to defend my background to others.
- I learned that although I personally am a double minority and feel like I am at a disadvantage or other peers will judge me before knowing me, the same can go for a nonminority (white male). It was brought up in discussion that just because someone

is a white male doesn't mean they do not understand the minority's point of view; it is not fair to assume they are not concerned with the issues of minorities in the workplace or academia.

3. Did anything surprise you?

- I was astonished at how staggeringly low the statistics were for the various groups of minorities particularly Blacks/African-Americans in both absolute and relative terms.
- I was a bit surprised at the number of female researchers who are single. And their academic career does have some role in it. (I didn't expect it in a more developed country)
- I was surprised by the fact that there is a disconnect between funding agencies, principal investigators, and institutions on how to handle funding issues when a female graduate student needs to take maternity leave. Funding agencies believe institutions should have policies in place for such matters, principal investigators do not know of such policies and do not want a potential lack of productivity towards funding objectives to affect current or future funding, and institutions want more guidance from funding agencies.
- I was somewhat surprised at the range of people at the workshop from folks very active in the area of diversity to faculty and students who knew very little and were exploring the issues for the first time.
- I was surprised to learn how little faculty of color and women faculty there are in our field. I always knew that women and ethnically diverse people are minorities in the field, but I was surprised to see the numbers and how low they are. I was even more shocked at the double blind studies that were done for grant proposals and resumes. I didn't realize that in this day and age, people are still being overlooked for their names and gender.
- Nothing surprised me or took me off guard. It was all conversation I have discussed or participated in before, but at the workshop we went more in depth

4. Are there changes in the way you view others? Do you foresee changes in the way that you might behave?

- Having attended two of the most prominent HBCUs (Howard University and Florida A&M University), and recently becoming a member of the faculty at a Research I university, I already had a keen sense of the issues of the lack of diversity in STEM from a black male perspective. I am committed to seeking alliances with others who share a genuine desire to redress the lack of diversity in MSE.
- I gain more experience and get a bit more aware of others.
- I believe I have gained more appreciation of the challenges faculty of color, in particular double minorities, face on a daily basis. I will make more of an effort to be aware of my own unconscious biases and how these may be affecting how I treat others in the workplace. This will allow me to take corrective actions when needed.
- I think the presentations on mentoring were really valuable in helping me see what kinds of difficulties diverse students and faculty face. I think the intersection of race and gender is a particularly interesting and challenging situation. African-American women, for instance, seem to have a double challenge in engineering. Support may not be so easy to find.
- Yes, I do view people differently after this workshop. Knowing about our unconscious biases, it is easier for me to understand and have empathy for others in the workshop. I think that this has helped me to be more patient with people and fair as well.
- I see slight changes in the way I might behave such as just trying to view every individual as a clean slate and get to know them before assuming something about them.

5. Do you see yourself becoming a proactive force for change? In what ways?

- I am encouraged by the evidence that the NSF and DOE view diversity as an important issue and I am now even more committed to working toward increasing the numbers and improving the experience for members of minority groups in MSE. I will seek out opportunities for outreach and offer mentoring to minority graduate students and post docs. I will also form networks and alliances with other minority faculty in STEM. I will reach out to majority members of faculty, program managers and leaders within the NSF, DOE, national laboratories and industry who consider diversity to be important.
- At this time, I think the workshop content will mostly serve as food for thought for me. However, in addition, I am also coordinating a graduate student session to cultivate a positive department culture per the request of my department head.
- I'll pay more attention to my own bias when judging someone. To me personally, self-awareness is most difficult to achieve.
- I do see myself becoming a proactive force for change. Specifically, I intend to set or highlight policies in my lab for female researchers regarding maternity leave and child care. I will try to serve on search committees to provide perspectives as an ethnic minority, and I will use any influence I may have as a Professor to recruit a diverse pool of students into the Materials Science and Engineering field.
- I do a lot of work in faculty development for faculty groups and graduate students in STEM. I think I'm now more aware of the importance of broadening my recommendations particularly for women and ethnic minorities to include suggestions about getting mentoring. I like the idea of a mentor team—empowering graduate students and faculty to assemble a number of people

to support them for different needs they have rather than trying to find the one perfect mentor who provides everything that they need. I also hope to write about the MSE survey findings to reach a wider audience than just the people who attended the workshop.

- Yes, I do see myself becoming a proactive force for change! I want to encourage and support underrepresented students to realize their full potential so that they may want to pursue a career in engineering. I will do this by offering research opportunities to undergraduate students (once I get a faculty position!) and showing them what they can do with materials science and how they can better themselves and their community through it. I will also encourage them to pursue graduate degrees.
- In the future I see myself being proactive about the cause, but as a student I feel I should focus on my schoolwork and career path so I can get into a position of authority and impact a large number of people.

6. Were there issues or topics that were not discussed at the Workshop that you feel should have been addressed?

- The workshop brought together representatives and stakeholders from several different perspectives. To the extent that the workshop was convened for the purpose of examining the issues of diversity and making recommendations for measures to increase the number of minority faculty in MSE, all of the most relevant issues were brought to the fore. What was the key factor that improved your success rate with proposal submission?
- Asians in the US are also diverse, many come from poor families, and they face their own difficulties as well. But in the workshop, they were rarely discussed about. Perhaps they are seen as financially well off as a whole.
- I believe this workshop covered the appropriate topics at this time.
- None that I can think of. The one suggestion I would make is that in future workshops of this type, in MSE or other STEM disciplines, time should be allocated to gather ideas and action items from attendees while at the workshop. I think that getting ideas from everyone while the information was fresh in their minds might have led to some useful outcomes and made people feel that something important would come out of the gathering.
- It was mentioned at the conference that many minorities come into the graduate level with lower GRE scores, GPA, etc., from this I think there should be a workshop on how to get minorities up to speed once they get into a graduate program. Whether that be testing to evaluate their weak spots and implementing a program to help them. I feel if they come in below the learning curve it will continue to get worst unless they have a good mentor.
- This might be a bit off-track from the question: I feel other types of diversity have very similar issues like ethnic diversity (age, religion, socio-economic background, disability, sexual orientation, gender expression...). And maybe they're worth discussing in this workshop too, since they can affect people's lives just as much.

7. Please suggest recommendations for actions that can be taken to improve the trajectory for ethnic diversity in materials science and engineering in the US. These recommendations can be aimed at any group in leadership/decision-making positions, including:

a. University department heads, deans, and student organizations

- Work with Federal TRiO programs to identify, recruit, and retain STEM/MSE students and/or to provide academic services for these students. Federal TRiO programs include Upward Bound, Student Support Services, and the Ronald E. McNair Postbaccalaureate Programs.
- Encourage institutions offering MSE degrees to maintain a database of Minority Based Scholarships and Fellowships. Departments should ensure this information is readily available on the departmental website. Many institutions, e.g. the Graduate College at Illinois, maintain searchable databases of fellowships, but these do not always include smaller awards at the regional level. (<https://www.grad.illinois.edu/fellowship/>)
- Encourage institutions offering MSE degrees to provide application fee waivers and GRE support for undergraduate students applying to their graduate MSE programs, including support for their students applying to graduate programs at partner institutions.
- Encourage MSE departments to work closely with their Veterans Office to identify and recruit service members separating from the military.
- Support undergraduate students attending the Society of Hispanic Professional Engineers, the Society for the Advancement of Chicanos and Native Americans, the National Society for Black Engineers, and the Society of Women Engineers National Conference to present undergraduate research and participate in graduate school preparatory tracks.

b. National laboratory leadership

- Support MSE Departments to offer 5 years of guaranteed funding to minority students through a combination of fellowship (1st year) and research assistantships/teaching assistantships
- Establish and highlight clear maternity and paternity leave policies for graduate assistants.

- Offer health insurance supplements as part of research grants to ensure dependents of graduate assistants have medical coverage.
- Support the national conferences of the Society of Hispanic Professional Engineers, the Society for the Advancement of Chicanos and Native Americans, the National Society for Black Engineers, and the Society of Women Engineers National Conference. Encourage funding managers and research scientists to present research and participate in workshops to meet faculty of color and graduating students entering academia.

c. State/federal government elected officials

- Support continued funding of Federal TRiO programs.
- Work with the United States Department of Veterans Affairs to develop programs which transition veterans into materials related careers and MSE degree programs.

d. Professional societies

- Investigate the possibility of including a Diversity Section in the society publications. This could be used to highlight faculty of color research results and/or summarize research presented at the SHPE, SACNAS, SWE, and NSBE conference.
- Encourage society members to support legislation related to funding of Federal TRiO programs or other programs vital to improving diversity within the materials community.
- Many universities already have organizations for minorities in engineering but they are not focused on materials science and engineering. I believe the departments could start more focused clubs like this for MSE students and that the faculty could become involved. The faculty could have panels and workshops to get information to the students about how to excel and thrive in their programs. This can be a support group for the minority students when they are having trouble with their classes, professors, etc. The federal agencies and professional societies could have funded workshops for minority students to attend yearly or biannually. The students could apply to attend this workshop and admission to the workshop could be given as an award, so that this may help to pad their CV. The workshops can then give information on how the students can go above and beyond to be ahead of their peers and excel. This can be information of writing grants, doing research, mentoring/teaching students, etc.
- I think you should invite ETS so they can explain the way the GRE is set up and discuss if there are any biases in the formation of the test, if the test is made for "every" student in America and overseas (in many cases), etc. because this test discourages a lot of minorities and makes them feel less competitive, detouring them away from applying
- The way that minorities experience the professional arena is very complex and goes largely unknown to those who are not a member of a minority group except perhaps for a few who have consciously and deliberately made an effort to understand the nature of that experience. The nuances of the experience vary from one minority group to another in subtle ways by ethnicity and gender. Oftentimes it is not a case of deliberate bias that is at play but a lack of awareness of the historical challenges and the legacy of endemic roadblocks that "color" the experience of minorities pursuing careers in STEM.



APPENDIX B: MATERIALS SCIENCE AND ENGINEERING GRADUATE STUDENT SURVEY

1. What were the factors that influenced you to choose Materials Science and Engineering? Mark all that apply.

- Encouraged by my high school teachers or counselors
- Encouraged by an undergraduate advisor
- Encouraged by teacher(s) in undergraduate courses
- Encouraged by peers/fellow students
- Encouraged by family
- Other (please specify) _____

2. What were the factors that influenced you to select your current graduate program?

- Reputation of the university
- Reputation of the program
- Personal contact with graduate students in the program
- Encouraged by undergraduate advisor
- Encouraged by teacher(s) in undergraduate program
- Encouraged by peers/fellow students
- Encouraged by family
- Received financial support
- Desirable location
- Other (please specify) _____

3. Rate the following aspects of your program as Excellent, Good, Satisfactory, Poor or N/A:

- Quality of my coursework
- Support from my advisor
- My relationships with faculty in the department
- My relationships with other graduate students in the department
- Environment in the department for minority students
- Environment in the department for women students
- Other comments about your program _____

4. Which of the following experiences have you had as a part of your graduate program? Mark all that apply.

- Receiving guidance in conducting research
- Presenting my research at seminars at my university
- Presenting my research at a regional or national conference
- Authoring or co-authoring a paper on my research
- Being introduced by my advisor to faculty in my research area from other institutions
- Opportunities to cover one or more class or recitation sections
- The opportunity to teach a lecture course or recitation
- A workshop or course on teaching
- Opportunity to mentor an undergraduate student
- Receiving career advice from my advisor
- Receiving personal advice from my advisor
- Other experiences and comments

5. What degree are you working toward in your current program?

- Master's with thesis
- Master's without thesis
- Doctorate

6. How many years have you completed in your current program? (0, 1, 2, 3, 4, 5, More than 5)

7. What are your career plans after you graduate?

- Seek employment in industry or government
- Seek employment in academia

- Seek employment in industry and then in academia
- Seek a postdoc and then employment in industry or government
- Seek a postdoc and then employment in academia
- I do not plan to seek employment after I graduate.
- Other (please specify) _____

8. Would you like to work in academia? (Yes, No) If your answer is no, please explain why. _____

9. Do you plan to stay in the discipline of Materials Science and Engineering? (Yes, No) If your answer is no, please explain why. _____

10. Have your career plans changed since you started your graduate program? (Yes, No) If yes, please explain.

11. After completing your education, where do you plan to work? (In the United States, Outside of the United States)

12. Are you male or female (Male, Female)

13. What is your ethnicity? (Hispanic/Latino, Not Hispanic or Latino)

14. What is your race? Mark one or more.

- American Indian / Alaska Native
- Asian
- Black or African American
- Native Hawaiian or Other Pacific Islander
- White

15. What is your citizenship?

- US Citizen or national
- Permanent Resident
- Other non-US Citizen (temporary resident)

16. What was your major as an undergraduate?

- Chemical Engineering
- Chemistry
- Civil Engineering
- Materials Science and Engineering
- Mechanical Engineering
- Physics
- Other (please specify) _____

APPENDIX C: MATERIALS SCIENCE AND ENGINEERING RECENT GRADUATE SURVEY

1. Are you still in the field of Materials Science and Engineering? (Yes, No)

2. What are you doing now? Mark all that apply.

- Seeking another degree
- Working in a postdoc position
- Working in industry
- Working in government
- Tenure-track position in academia
- Non-tenure-track position in academia
- Other (please specify) _____

3. What factors went into your career decision? Mark all that apply.

- Salary and benefits
- Geographic location
- Chance to work on important problems
- Chance for independent research
- Job security
- Opportunity for balanced work and personal life
- Influence of a family member
- Influence of advisor
- Consideration of spouse's or partner's professional position
- Other (please specify) _____

4. Have your career plans changed since you completed your graduate program? (Yes, No) If yes, explain the changes.

5. Where do you plan to work permanently?

- In the United States
- Outside of the United States

6. Please indicate your plans about working in academia.

- I already have a position in academia.
- I hope to work in academia in the future.
- I do not plan to work in academia in the future.
- If you do NOT plan to work in academia, please explain why. _____

7. Rate the following aspects of your graduate program as Excellent, Good, Satisfactory, Poor, or N/A:

- Quality of my coursework
- Support from my advisor
- My relationships with faculty in the department
- My relationships with other graduate students in the department
- Environment in the department for minority students
- Environment in the department for women students
- Other comments about your program _____

8. Which of the following experiences did you have as a part of your graduate program? Mark all that apply.

- Receiving guidance in conducting research
- Presenting my research at seminars at my university
- Presenting my research at a regional or national conference
- Authoring or co-authoring a paper on my research
- Being introduced by my advisor to faculty in my research area from other institutions

- Opportunities to cover one or more class or recitation sections
- The opportunity to teach a lecture course or recitation
- A workshop or course on teaching
- A seminar or workshop on getting an academic position or succeeding in an academic career
- Opportunity to mentor an undergraduate student
- Receiving career advice from my advisor
- Receiving personal advice from my advisor
- Please describe any other experiences in your graduate program that you considered meaningful.

9. Are you male or female (Male, Female)

10. What is your ethnicity? (Hispanic/Latino, Not Hispanic or Latino)

11. What is your race? Mark one or more.

- American Indian / Alaska Native
- Asian
- Black or African American
- Native Hawaiian or Other Pacific Islander
- White

12. What is your citizenship?

- US Citizen or national
- Permanent Resident
- Temporary Resident

APPENDIX D: ATTENDEE LIST

LAST	FIRST	AFFILIATIONS
Acoff	Viola	The University of Alabama
Akkara	Joseph	National Science Foundation
Al Balushi	Zakaria	Pennsylvania State University
Alford	Terry	Arizona State University
Alpay	Pamir	University of Connecticut
Arroyave	Raymundo	Texas A & M University
Bahr	David	Purdue University
Belvin	Anthony	Department of Defense
Bharadwaj	Maneel	University of Tennessee Knoxville
Bobea	Milena	NC State University (Graduate Student)
Bowman	Keith	Illinois Institute of Technology
Brent	C. Rebecca	Education Designs, Inc.
Briber	Robert	University of Maryland
Buchheit	Rudy	Ohio State University
Burrell	Dr. Reeshemah	National Science Foundation
Butt	Darryl	Boise State University
Cahill	David	University of Illinois at Urbana-Champaign
Campbell	Nicole	Raytheon
Chabal	Yves	University of Texas, Dallas
Colina	Coray	Pennsylvania State University
Collazo	Ramon	North Carolina State University
Constant	Kristen	Iowa State
Darwish	Abdalla	Dillard University
De Leon	J. Eliseo	Iowa State University
Deml	Ann	Colorado School of Mines
Diaz Rivas	Rosa	Brookhaven National Laboratory

Dobbins	Tabbetha	Rowan University
Dubon	Oscar	University of California Berkeley
Edwards	Doreen	Alfred University
Emory	Elaine	North Carolina State University
Esteves	Giovanni	University of Florida (Graduate Student)
Estrada	David	University of Illinois at Urbana-Champaign (Graduate Student)
Evans-Lutterodt	Kenneth	Brookhaven National Laboratory
Farkas	Diana	National Science Foundation
Field	David	Washington State University
Field	David	Washington State University
Fine	Eve	University of Wisconsin Madison
Garay	Javier	University of California Riverside
Gerhardt	Rosario	Georgia Institute of Technology
Gordon	Renee	Florida A & M University
Graeve	Olivia	University of California San Diego
Grant	Christine	North Carolina State University
Gumpertz	Marcia	North Carolina State University
Harrison	Joycelyn	Air Force Office of Scientific Research
Hayami	Christine	North Carolina State University
Herbers	Joan	Ohio State University
Hicks	Janice	National Science Foundation
Horton	Linda	Department of Energy
Hughes	Roxanne	Florida State University
Huh	Uk	University of Tennessee Knoxville
Hull	Robert	Rensselaer Polytechnic Institute
Hunte	Frank	North Carolina State University
Hussey	Lindsay	NC State University (Graduate Student)
Ishmael	Sasha	North Carolina State University
Jeelani	Shaik	Tuskegee University
Johnson	Brienne	University of Florida (Graduate Student)
Johnson	William	University of Virginia
Jones	Andrew	Florida A & M University
Jones	Sean	National Science Foundation
Juma	Booker	Fayetteville State University
Kampe	Stephen	Michigan Tech
Kaufman	Michael	Colorado School of Mines
Kaufman	Rachel	
Kerch	Helen	Department of Energy
Lacerda	Alex	Los Alamos National Lab
Lara-Curzio	Edgar	Oak Ridge National Lab
Lavernia	Enrique	University of California Davis
Le	Quang	NC State University (Graduate Student)
Ledbetter	Abe	Brookhaven National Laboratory (Graduate Student)
Lovinger	Andrew	National Science Foundation
Madsen	Lynette	National Science Foundation
Majikes	Jacob	NC State University (Graduate Student)
Manuel	Michele	University of Florida
Marchany	Michelle	SUNY Buffalo
Martin	David	University of Delaware
Martin-Vega	Louis	North Carolina State University
Mathaudhu	Suveen	Army Research Office
McGuffin-Cawley	James D.	Case Western Reserve
Meda	Lamartine	Xavier University of Louisiana
Melton	Mark	St. Augustine's University
Meng	Fang	University of Tennessee Knoxville

Narayan	Jay	North Carolina State University
Nordahl	C. Scott	Raytheon
Nutt	Steve	University of Southern California
Ogonji	Gilbert	Coppin State University
Olatidoye	Olugbemiga	Clark Atlanta University
Palazoglu	Ahmet	University of California Davis
Pantula	Sastry	National Science Foundation
Phillips	Makita	North Carolina State University
Phillpot	Simon	University of Florida
Pines	Darryll	University of Maryland
Popovic	Dragana	Florida State University
Ramalingam	Subramanian	Colorado School of Mines
Rankins	Claudia	National Science Foundation
Redwing	Joan	Pennsylvania State University
Robertson	Ian	National Science Foundation
Roca	Alberto	MinorityPostdoc.org
Rohlfing	Celeste	National Science Foundation
Rohrer	Greg	Carnegie Mellon University
Ross	Dena	Boise State University
Sanders	Tarielle	University of Florida (Graduate Student)
Santiago	Victor	National Science Foundation
Schwartz	Lyle	Lyle Schwartz
Schwartz	Justin	North Carolina State University
Shull	Robert	National Institute of Standards and Technology
Smith	Richard	National Science Foundation
Snowden	Frank	University of Minnesota
Snyder	John	National Science Foundation
Spector	Magaly	University of Texas, Dallas
Strauss	Bruce	Department of Energy
Stroe	Izabela	Worcester Polytechnic Institute
Taleff	Eric	National Science Foundation
Tessema	Guebre X	National Science Foundation
Thadhani	Naresh	Georgia Institute of Technology
Tillie	Chakila	Air Force Office of Scientific Research
Trent	Alexis	North Carolina A&T State University
Tung	Toby	North Carolina State University
Uwakweh	Oswald	University of Puerto Rico at Mayaguez
Vinces	Marcelo	National Science Foundation
White	Ashley	National Science Foundation
Widgeon	Scarlett	University of California Davis (Graduate Student)
Williams	Denese	National Science Foundation
Ying	Charles	National Science Foundation
Zapf	Vivien	Los Alamos National Lab
Zavaliangos	Antonios	Drexel University

APPENDIX E: USEFUL REFERENCES

BOOKS

Dace, K. (2012) *Unlikely Allies in the Academy: Women of Color and White Women in Conversation*. New York: Routledge.

Mack, D., Watson, E. D. and Camacho, M. M. (2012) *Mentoring Faculty of Color: Essays on Professional Development and Advancement in Colleges and Universities*. (Chapter on Mentoring by conference presenter C. S. Grant.)

Pritchard, P .A. (2001). *Success Strategies for Women in Science: The Portable Mentor*. Burlington, MA: Elsevier Academic Press.

Stanley, Christine A. (2006). *Faculty of Color Teaching in Predominantly White Colleges and Universities*. San Francisco: Jossey-Bass.

WEBSITES

Seeking Solutions: Maximizing American Talent by Advancing Women of Color in Academia <http://sites.nas.edu/wocconference/>
This website has information on the conference and also has a link to a exhaustive list of references, see <http://sites.nas.edu/wocconference/resources/>

NSF ADVANCE Initiatives - supported by NSF ADVANCE Grants:
Advancing Women in Engineering & Technology @ HBCUs (PVAMU): PI - Nave

Cross-Disciplinary Initiative for Minority Women Faculty (GA Tech): PI- Barabino

Peer Mentoring Summits for URM Women Engineering Faculty (NCSU): PI- Grant

Purdue STEM Women of Color (WOC) Conference (Purdue): PI- Sahley

STEM Women of Color Conclave

Transforming the Climate and Advancing STEM Women at JSU, an HBCU in the South (Jackson State U): PI-Moore

Women of Color Faculty in STEM as Change Agents (Howard U.): PI- Winston

OTHER INITIATIVES

Maximizing American Talent by Advancing WOC in Academia (Nat. Academies)

National Science Board (2004). *Broadening participation in science and engineering faculty*. Arlington, VA: National Science Foundation (NSB-0441). <http://www.nsf.gov/pubs/2004/nsb0441/nsb0441.pdf>

Nelson, D. (2007). *A national analysis of minorities in science and engineering faculties at research universities*. http://cheminfo.ou.edu/~djn/diversity/Faculty_Tables_FY07/07Report.pdf

Sisters of the Academy (SOTA): Minority women faculty Academic Career conference *Faculty Women of Color in the Academy conference
<http://inclusiveillinois.illinois.edu/WCA/> (2013)

ARTICLES AND REPORTS

Building Engineering and Science Talent (2004). *A Bridge for all: Higher education design principles to broaden participation in science, technology, engineering and mathematics*. San Diego: CA: Building Engineering and Science Talent. http://www.bestworkforce.org/PDFdocs/BEST_BridgeforAll_HighEdFINAL.pdf

Caffarella, R. S. (1993). *Psychosocial development of women: Linkages to teaching and leadership in adult education*. (Information Series No. 350). Columbus, Ohio: ERIC Clearinghouse on Adult, Career, and Vocational Education.

DeCuir-Gunby, J. T., Long-Mitchell, L., & Grant, C. (2009). The emotionality of being women professors of color in engineering: A critical race theory and critical race feminism perspective. In P. A. Schutz & M. Zembylas (Eds), *Advances in teacher emotion research: The impact on teachers' lives*. New York, NY: Springer Publishing.

Leggon, C. (2001). African American and Hispanic Women in Science and Engineering. *Making Strides*, 3 (3), 7.

National Academy of Sciences, National Academy of Engineering, & Institute of Medicine. (2006). *Biological, social, and organizational components of success for women in academic science and engineering: Report of a workshop*. Washington, D.C.: National Academies Press.

National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. (2007). *Beyond bias and barriers: Fulfilling the potential of women in academic science and engineering*. Washington, DC: National Academies Press.

National Research Council. (2006). *To recruit and advance: Women students and faculty in science and engineering*. Washington, D.C.: National Academies Press.

Nelson, D. J., & Rogers, D. C. (2005). A national analysis of diversity in science and engineering faculties at research universities. Norman, OK. January, 2005. <http://cheminfo.chem.ou.edu/~djn/diversity/briefings/Diversity%20Report%20Final.pdf>

Ranson, G. (2005). No longer "one of the boys": Negotiations with motherhood, as prospect or reality, among women in engineering. *The Canadian Review of Sociology and Anthropology*, 42(2), 145-166.

Ronen, S. & Ronen, A. (2008). Gender differences in engineers' burnout. *Equal Opportunities International*, 27(8), 677-691.

Stanley, C. A., & Lincoln, Y. S. (2005). Cross-race faculty mentoring. *Change*, 37(2), 44-50.

Trower, C. A. , Chait, R. P. , "Faculty Diversity." *Harvard Magazine*, (March-April 2002)

Turner, C.S.V. (2002). "Women of Color in Academe: Living with Multiple Marginality." *The Journal of Higher Education*, 73(1) 74-93.

