Collaborative to Integrate Material Science and Engineering Research and Education (CIRE) Between Florida A&M University and Carnegie Mellon University

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• OBJECTIVES:

• To strengthen the quality of the materials science curriculum at FAMU,

• To provide more opportunities for minority students to participate in materials science research at FAMU and CMU,

• To enhance the materials research resources at both FAMU and CMU through shared equipment and software.
# CIRE Professors

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<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Title</th>
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<tbody>
<tr>
<td>B. L. Adams</td>
<td>CMU</td>
<td>Prof. of MSE, Ex-Director of the MIMP (presently at BYU)</td>
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<tr>
<td>K. Barmak</td>
<td>CMU</td>
<td>Assoc. Prof. of MSE</td>
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<td>H. Dahmen</td>
<td>FAMU</td>
<td>Associate Prof. Of Chemistry</td>
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<td>F. Foreman</td>
<td>FAMU</td>
<td>Assistant Prof. Of ME</td>
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<td>H. Garmestani</td>
<td>FAMU</td>
<td>Professor of ME</td>
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<td>P. N. Kalu</td>
<td>FAMU</td>
<td>Associate Professor of ME</td>
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<td>S. Peterson</td>
<td>FAMU</td>
<td>Associate Professor of ME</td>
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<td>G. S. Rohrer</td>
<td>CMU</td>
<td>Associate Professor of MSE, PI (Director of MIMP)</td>
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<td>A. Rollett</td>
<td>CMU</td>
<td>Professor of MSE</td>
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<td>J. Schwartz</td>
<td>FAMU</td>
<td>Professor of ME</td>
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<tr>
<td>S. Ta'asan</td>
<td>CMU</td>
<td>Professor of Mathematical Sciences</td>
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CIRE Between FAMU and CMU

• Mutual Benefit:
  – The principal need at FAMU is to enhance educational programs in the area of Material Science and Engineering through additional course offerings and research.
  – The facilities and activities of the MIMP program will continue to be an asset for the development of materials research.
  – This collaborative involving the exchange of faculty and students enhanced (and will continue to enhance) CMU’s ability to recruit qualified minority graduate students.
  – Furthermore, the exchange of software and instrument access benefits both institutions.
CIRE Between FAMU and CMU

Early success in Joint Activities:

- **Research**: Four Joint Publications over the last two years for only one team in the collaborative.

- **Educational interaction**: Resulted in the development of a *materials course* "Texture and Properties of Crystalline Materials" *via an internet video tele-conferencing link*.

- **Minority Graduate Students**: Four undergraduate students in the collaborative decided to go to graduate students (one to CMU).

- **Laboratory development**: resulted in a *materials laboratory*.

- **Symposium**: Organizing a Microstructure sensitive Design *symposium* in the International Conf. On Plasticity.
CIRE Between FAMU and CMU

Interactions:

- **Workshops**: Two workshops were organized since funding
- **Research teams**: Constant interaction between the collaborators.
- **Travel**: several travels by the investigators in CIRE
Student Exchange Program

- Four students were sent to CMU for Summer 2000
- (Right to left)
  - Trishia Bennet
  - Michelle Adams
  - Oscar Castillo
  - Antoine Berret
Minority Graduate Students

• From the four students attending the first CIRE’s Summer program, only one graduated this year (Trishia Bennet)

• Trishia Bennet (a student of Dr. Kalu) decided to go to graduate school at CMU

• This means 100% success rate for the Summer program so far!
Four CIRE Minority Students going to Graduate schools

• Trishia Bennet, CMU
• Michael Brown, Caltech
• Karen Davis, MIT
• Loren Rideout, Stanford
Four CIRE Minority Students going to Graduate schools

- This translates into:
- 75% women, 25% men
- 75% African American, 25% Asian American

Michael Brown, Caltech:
“I did not like materials science but since I worked with Dr. Kalu I decided to continue in Materials Science”.

CIRE (FAMU and CMU)

- Educational Interaction:
  - Texture and Properties of Crystalline Materials I&II, students from FAMU and CMU, 1999-2001
  - Originally using ISDN lines and gradually a full internet based tele-video conferencing
  - Improved IP lines and hardwares for both FAMU and CMU
  - We plan to teach Applied Superconductivity at FAMU-FSU in the fall, with link to CMU and Lehigh for their enrollment too
CIRE Research Teams

- Five research teams between the two Universities:
  - Inelastic Deformation in Polycrystalline Materials (H. Garmestani and B. L. Adams)
  - Interfacial Energies in Superconducting Ceramics (S.C. Peterson and G.S. Rohrer)
  - Texture and Grain Boundary Energy Characterization of Materials During Recrystallization (P.N. Kalu, A. Rollett)
  - Multiscale Numerical Simulation for Nanostructured Materials (F. Foreman, B. L. Adams, and S. Ta’asan)
  - Materials Improvement of Superconducting Electronic Devices (J. Schwartz and K. Barmak)
Material’s Laboratory Development

• **Materials Laboratory:**
  - Design and construction of a *materials laboratory* with the help of Professors at CMU (first lab performed Fall 2000)
  - Joint Collaboration of Professor P. Kalu and Dr. Rohrer for the construction of a materials laboratory
  - Purchase of over 240k of laboratory equipment
CIRE Accomplishments

• **Student Exchange Program:**
  - A total of 12 students were hired for the first year.
  - Presently a total of 12 students are presently hired:
    - Justin Schwartz: 2
    - Peter Kalu: 4
    - Simone Peterson: 1
    - Hamid Garmestani: 3
    - Klaus Dahmen: 2
  - Three more for the Summer program
CIRE Accomplishments

• **Student Exchange Program:**
  - Four students were sent to CMU for Summer 2000
  - *Three* live video teleconferencing held.
    - Need to plan for more teleconferencing with student’s presentations
  - Six students are identified and will be sent to CMU this year (starting June 4th).
CIRE Research Accomplishments

• Very strong research interaction between the groups
  – Six papers published (or accepted) in the collaborative
  – Two papers are accepted for publication with the participation of the undergraduate students (as co-authors)!
  – Five more papers planned for the next year between the collaborative teams
CIRE Research Accomplishments

- **Papers published as part of the collaborative effort:**


  6) L. Meda, L. Kennon, C. Bacaltchuck, K.H-Dahmen, H. Garmestani, “The effects of thermal annealing on the texture of La_{0.67}Sr_{0.33}MnO_3 thin films”, *J. Mater. Res.* (accepted).
CIRE Accomplishments

- To strengthen the quality of the materials science curriculum at FAMU,:
  - Five materials courses were created (only 3 promised)
    - Materials Characterization (Peterson)-Spring 2000
    - Texture-I (Adams)-Spring 2000
    - Texture II-(Microstructure) (Rollett)-Spring 2001
    - X-ray Diffraction (Garmestani)-Spring 2001
    - Mechanics of Composites (Garmestani)-Fall 2000
Summary of expenses

- 240k worth of equipment was purchased over the last two years
- 40k of Multi media facility
- Travels, workshops, conferences: $33k
- Faculty salaries: $72k
- Student salary (including 2000 summer program): $203k
- Staff: $48k
- CMU: $107k
Summary of expenses

- 240k worth of equipment was purchased over the last two years
  - Three furnaces (56k)
  - Three Microscopes (75k)
  - Nano-indentation facility (64k out of 140k - the rest by a match from other groups, biology, ..)
  - 8 computers (~12k)
  - Data acquisition facility: (8k)
  - Image Pro software: (5k)
  - Laboratory equipment Laser printer, (1500)
  - Laboratory Expense: (8k)
  - Publication, .. (3.5k)
  - Upgrade of software (operating systems, ..), 4k
  - Finite Element Package and MatLab (6k)
CIRE Accomplishments

• To strengthen the quality of the materials science curriculum at FAMU,
  – A materials Lab (recrystallization and heat treatment) was created as part of Solid Mechanics Lab
  – Students were able to perform heat treatment
  – Polished samples
  – Operated optical microscopes
  – Performed image analysis and materials analysis
CIRE Accomplishments

- Provided more opportunities for minority students to participate in materials science research at FAMU and CMU,
  - Four minority students were sent to CMU and participated in research
  - Four minority students were sent to the Gordon conference while attending CMU
  - 5 more minority (together with three other students) attended the ASME conference.
  - Laquitta Kennon: One Journal Paper, presenting a paper at MRS
  - Cassandra Fountain: One Journal paper and one proceeding
CIRE Accomplishments

- Unique facility accessible by FAMU Professors,

*Example:*
Collaborative work on magnetic annealing of steel with
Garmestani, Kalu (FAMU)
Rollett (CMU)

- Resistive magnet, 195 mm bore, 8 Tesla
- High Tₐ furnace
- Rod
- Hot zone, 1200 ° & 1600 ° C
CIRE Accomplishments

- **Papers by undergraduate students (as co-authors):**
  - L. Meda, L. Kennon, C. Bacaltchuck, K.H-Dahmen, H. Garmestani, “The effects of thermal annealing on the texture of La$_{0.67}$Sr$_{0.33}$MnO$_3$ thin films”, *J. Mater. Res.* (accepted).
Future Papers by undergraduate

• **Credle Sydni**, Peter Kalu, "Texture Development in Heavily Deformed and Annealed OFHC Cu Wire", to be submitted to Metallurgica Transactions,

• L. Meda, **L. Kennon**, and H Garmestani Residual stress and epitaxial studies of LSMO thin Films, Solid State Communications (in preparation).

• P. Kalu, **T. Bennett**, T. Rollet,"The effect of Misorientation Angle on Abnormal Grain Growth in Silicon Steel" to be submitted.

Credle Sydni, one of the six participants in the CIRE Summer Program at CMU
CIRE Accomplishments

• Mutual Benefit:
  – This collaborative involving the exchange of faculty and students enhance CMU’s ability to recruit qualified minority scholars at all levels:
    • Dr. Adams is serving in two minority graduate students Ph.D. committee
    • Dr. Rollet and Dr. Barmaki will be serving in the Ph.D. committees of two other graduate students
    • One of the Minority students (Trishia Bennet) in the CIRE Summer program was accepted in graduate school at CMU.
    • Three more participants were accepted at MIT, Caltech and Stanford
    • A number of proposals were submitted jointly and one was funded between Dr. Rollett and Kalu
CIRE Accomplishments

- **Multi-media web course offering:**
  - X-ray diffraction was offered as a web course and offered to students at Georgia Tech.
  - $40k of multimedia instrumentation for teleconferencing enabling courses to be offered through the web.
Future!?
Future!?

The CIRE will be sustained beyond the three year funding because:

• The student activity will continue at a 60% level through a match by FAMU
• Web-courses will be offered annually jointly between the two institutions (and possibly others).
• The research collaborative will continue