The Materials Program at AUST and Future RISE Collaborations

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The Nelson Mandela Institutions (NMIs) of The African Institutes of Science & Technology (AISTs)

- The objective of NMIs is develop world class institutions that can use science and technology as tools to solve African problems
- The basic goal is to create world class African Institutes of Science & Technology (AISTs) in Africa
  - Similar to the Indian Institutes of Science and Technology (IITs/IIS)
  - The first of these is the African University of Science and Technology in Abuja (AUST-Abuja)
  - AUST- Abuja was established in 2007 (NUC approval) with support from the Federal government of Nigeria, PTDF, FCT, World Bank and the global scientific community
  - Goal is to establish other campuses across sub-Saharan Africa

The Pan-African NMI Flower Model

The Uniqueness of AUST-Abuja

- Recruit students from Sub-Saharan Africa - **focus initially on graduate education in science & technology**
- Use merit-based common entrance exam to select the best and brightest students with the potential to become leaders
- Engage leading international scientists and engineers, and African diaspora in **teaching, research and outreach to industry and the community (turn brain drain to circulation)**
- Develop **bottom-up entrepreneurial approach** to education, research and innovation that can solve African problems
- Adopt **transparent approach to governance and fundraising**
- **Develop endowment** that could ensure sustainable future funding of infrastructure, positions, education, research and innovation
- Establish **networks/linkages** with other universities and industry to **diffuse knowledge and innovation across Africa**

Initial Areas of Focus of AUST-Abuja

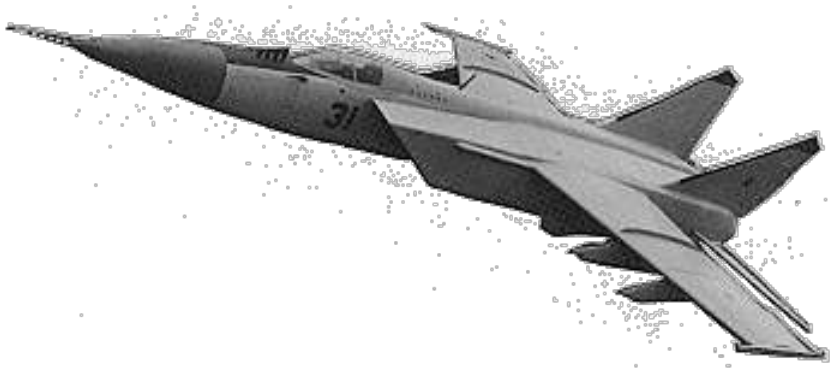
- Initial focus on graduate programs that address African problems
  - Petroleum engineering
  - Materials science and engineering
  - Computer science
  - Pure and applied mathematics
  - Theoretical and applied physics
- Interdisciplinary programs in the following areas
  - Biological sciences and engineering
  - Energy and environmental engineering
  - Business and innovation

Materials – The Major Driver

- Materials have always been a major driver in technological change…
  - Alloys
  - Semiconductors
  - Polymers
  - …

Hard materials

Soft materials



Materials@AUST

- 11 Masters Students
- 16 PhD Students
- 2 Resident Professors
- 5 Part-Time Professors
- 20 Visiting Professors

Teaching of Materials

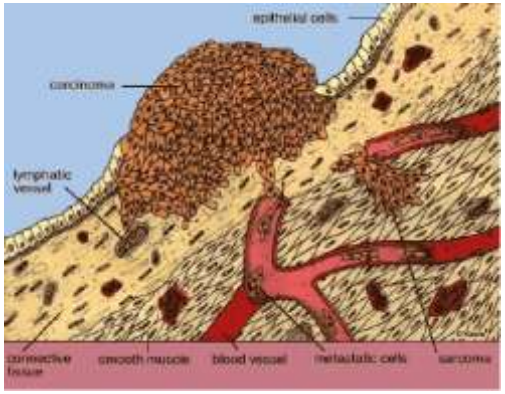
- Introduction to materials science and engineering
- Fundamentals - thermodynamics, kinetics, structure and materials characterization, mechanical properties of materials and electrical properties of materials
- Applications of materials science and engineering, composites, biomaterials, nanomaterials, mining and minerals processing, materials processing, corrosion, fatigue and fracture, non destructive evaluation

Materials Research@AUST

- Four thematic areas that address African needs and opportunities
  - Materials for human health
  - Materials for energy
  - Materials for water purification
  - Materials for sustainable housing

Systems-Based Interdisciplinary Materials Research

- Advanced Materials (Bio and Nano)
  - Targeting of disease
  - Alternative energy
- Societal Development
  - Affordable infrastructure e.g. recycling of agricultural & industrial waste
  - Value addition to minerals and natural products (Africa's silicon)



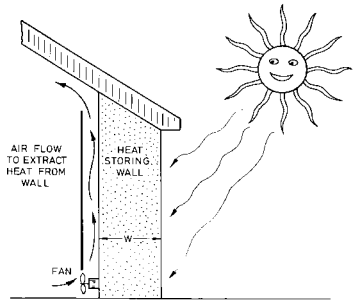
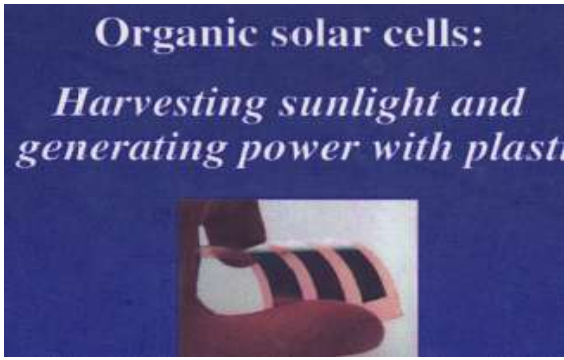


FIG. 6.32 A heat-storing wall. The sun shines on the outside during the day; heat is extracted from the inside at night. The heat diffusion time through the wall must be about 12 hours.



Education and Outreach

- AUST is currently hosting the RISE office in Africa as well as the Africa MRS Head Quarters
  - African staff working with U.S. staff
  - Stakeholder development with embassies & funding agencies
- Staff also also helped with the African MRS
  - African MRS and African MRS Student chapter
  - New effort to build student engagement in materials
  - Potential link with AMSEN and other RISE centers with an interest in materials

Joint RISE-AUST PASMAT Workshop

- Jointly organized workshop on materials – co-organized by RISE, AMSEN and AUST in 2011
- Two weeks of courses in materials fundamentals and applications + networking opportunities for students
- Fundamentals
  - Phase diagrams (Lesley Cornish)
  - Fatigue and fracture and finite element modeling (Wole Soboyejo and Jing Du)
- Applications
  - BioMEMS/nanoparticles for disease detection and treatment
  - Organic electronics
- Potential model for future workshops e.g. in natural products, life sciences, water and materials

Suggested Future Workshops

- The leadership of NM-AIST Arusha, 2iE and AUST would like to work closely with RISE on the organization of future workshops
- The goal will be to strengthen Pan African interactions in selected areas
- The initial areas could include workshops on
  - Life sciences and natural products
  - Water and the environment
  - Materials
- These could use the PASMAT format and reach out to multiple fields (real value addition beyond the core)
- Suggest we start planning and execution in 2013

Potential for RISE/AMSEN Collaborations With AUST

- Research
  - Wear and mechanical properties of hard materials e.g. cutting tools for mining
  - Materials for energy e.g. solar, OLED, energy storage
- Student exchange
  - Use of materials characterization facilities
  - Reinforce materials fundamentals and applications
- Faculty exchange and joint supervision
  - Teaching of selected courses
  - Joint supervision of PhD students

RISE/2iE/NM-AIST Arusha/AUST Research Linkages

- The goal should be to facilitate the interactions between RISE Centers and NMI Centers through natural research linkages
- These could be facilitated by the co-supervision and joint research projects
- Natural interactions between emerging centers following joint interactions between stakeholders
- Selected areas could include
  - Water and environmental engineering
  - Life sciences and natural products
  - Materials science and engineering

Beyond Research

- Need to explore interactions that range from ideas to markets……..
- A key component of the interaction should focus on industrial interactions
- Two types of industrial interactions should be explored
  - Interactions with existing industry
  - The creation of new industry/innovation hubs
- The latter requires a focus on innovation e.g. joint 2iE/AUST program on business and innovation
- These interactions could be the basis for the long term sustainability of our joint efforts

Mining and Mineral Processing – Africa's Silicon

- There is a need for us to recognize the need to strengthen Africa's major industry through our joint research and education
- As such our activities could be strengthened through collaborations in teaching and research
  - Mining and minerals beneficiation
  - Environmental beneficiation
  - Value addition to materials for multifunctional applications

Bio-Pharma and Natural Products

- Need to think strategically about natural products and their applications….
- The needs for local and global markets are different
- Applications should range from natural foods to cosmetics and medicines
- Natural foods and cosmetics have low thresholds to applications
- Medicine requires ethical animal/human trials and human trials – longer time scale for development and $
- Research must target emerging interest in natural foods, cosmetics and medicines e.g. Chinese strategy

Bamboo Frame Bicycle

Nick Frey, Will Watts, Douglas Wolf, Tom Yersak
Ezekiel Odeh

The Role of Networks

- The key is to use networks as catalysts for economic development
- Their potential has already been demonstrated recently by Nigerians in the **movie, spare parts, banking and religion industries**
- Similar networks are possible in the "knowledge" industry by forming networks that link
  - Africa to Africa
  - the international/diaspora to Africa
- However the span of activities must range from ideas to markets…
- This in my mind is the next frontier for RISE and NMIs

Summary and Concluding Remarks

- This talk presents an overview of the AUST materials program and potential interactions with RISE
- The first part of the talk included an overview of the AUST materials program
- This was followed by a brief description of the PASMAT program and the potential extension to other areas of interaction with RISE
  - Water and environmental engineering
  - Life sciences and natural products
  - Materials science and engineering
- Some initial ideas were then presented for the transition from ideas to markets
- We look forward to future interactions…


THANK YOU!