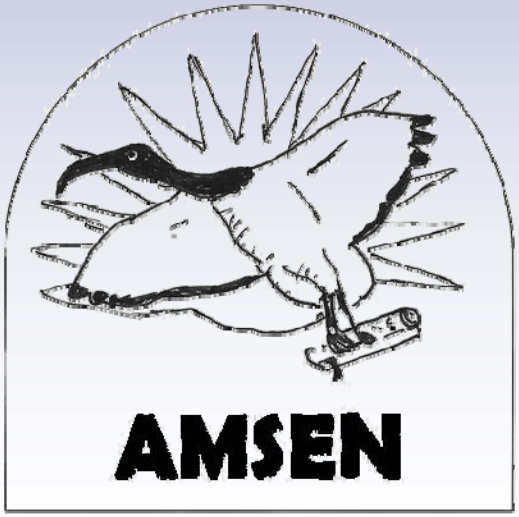
Genesis of a new Network: African Materials Science and Engineering Network (AMSEN)

L.A. Cornish and F.P.L. Kavishe



DST/NRF Centre of Excellence in Strong Materials (CoE-SM)

2004: Six Focus Areas:

- **Hardmetals Focus Area**
- **Ceramics Focus Area**
- **Diamond, Thin Hard Films and Related Materials Focus Area**
- **New Ultrahard Materials Focus Area**
- **Strong Metallic Alloys Focus Area**
- **Carbon Nanotubes and Strong Composites**

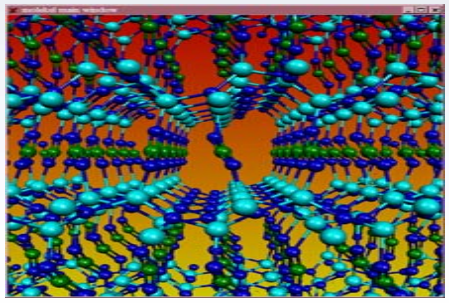
DST/NRF Centre of Excellence in Strong Materials (CoE-SM)

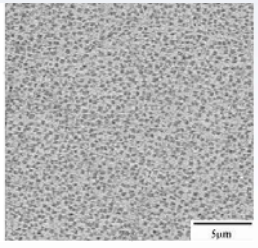
Development of applied materials that need good mechanical properties

Usually in aggressive environments:

- Temperature extremes
- High pressure
- Corrosive
- Radiation

Industry driven





Institutions involved in the CoE-SM

HARDMETALS FOCUS AREA

Wits, U. Johannesburg, National Energy Corporation SA

CERAMICS FOCUS AREA

Wits, Nelson Mandela Metropolitan U. + strong support from Element Six

DIAMOND, THIN HARD FILMS AND RELATED MATERIALS FOCUS AREA

Wits, National Energy Corporation SA

NEW ULTRAHARD MATERIALS FOCUS AREA

Wits , U. Kwa-Zulu-Natal + support from Element Six

STRONG METALLIC ALLOYS FOCUS AREA

Mintek (Advanced Materials), Wits, Nelson Mandela Metropolitan U., U. Limpopo

CARBON NANOTUBES AND STRONG COMPOSITES

Wits, U. Johannesburg

Wits: 2 Faculties: Science and Engineering & the Built Environment: Physics, Chemistry, Chemical and Metallurgical Engineering, Mechanical Engineering

Overseas Collaborations:

- Fachhochschule Jena, Germany
- Bayreuth University, Germany
- Leeds University, UK
- NIMS, Japan
- Oxford University, UK
- Nottingham University, UK
- Los Alamos Nuclear Science Centre, USA
- Synchrotron Radiation Source, UK
- Technical University Darmstadt, Germany
- MIT, USA
- U. Kaiserslautern, Germany
- U. Paris-North, France
- CNRS, France
- ALS, Berkeley, USA
- Center for Nanotechnology, NASA, USA
- University of Roma-2, Italy
- Centre of Advanced Technologies, Algiers, Algeria
- ESRF, Element Six
- CERN-CRYSTAL project
- National University of Malaysia
- Anna University, India
- Indian Institute of Technology, Kanpur, India
- IBSA interactions
- McMaster University, Canada
- University of Mondragon, Spain

Success of the CoE-SM

- Good throughput of students: at least 44 graduated since 2004, from at least 10 different countries
- Increased postdoctoral fellow numbers
- Papers published in journals: at least 40 per year
- Conference papers: at least 30 per year
- Patents
- Raise at least 100% more funding than provided by the NRF
- Good networking & collaboration
- Most of the graduates find employment in industry

Benefits of sufficient critical mass

Students!

Access to essential equipment

Awareness

Collaborations

Really good for leveraging other funds!

Carnegie-IAS Regional Initiative in Science and Education

- Call for proposals for March 2008
- Used contacts and the web to devise a network on Materials
- Successful proposal was one of 5 from 48 applicants: July 2008

Nodes in AMSEN

DST/NRF Centre of Excellence in Strong Materials,
University of the Witwatersrand, South Africa
Prof. L.A. Cornish (Director)

University of Nairobi, Kenya
Prof. G.O. Rading (Deputy Director)

University of Namibia, Namibia
Prof. F.P.L. Kavishe (Head of Secretariat)

Federal University of Technology, Akure, Nigeria
Prof. J.O. Borode

University of Botswana, Botswana
Prof. P.K. Jain

AMSEN

AMSEN

Aims

- Research
- Training + mentoring (co-supervise students with more experienced staff within the Nodes)
- Build capacity
- Want to exploit the respective strengths of individual partner institutions for the collective benefit to build capacity
- Encourage Intra-Africa cooperation among the five Universities and encourage sharing of both manpower and equipment
- Widen the exposure of the selected students via multiple supervision and regular travel within the Nodes

Five Key Performance Areas

1. Research
2. Education & Training
3. Information Brokerage
4. Networking
5. Service rendering

Research Plan

- Build strong teams of researchers in related fields of materials to supervise the students
- Assess the expertise and experience in the network has been assessed
- Identify overall research areas + members
- Set up individual projects, using a team of supervisors in the different universities
- Members complement each other
- Opportunity to bring less experienced members in the supervisory teams, so that they can be mentored in the area of undertaking research.
- Where possible, use post doctorate fellows to undertake research + help students

Research Plan cont.

- Students will have a home university, but will spend time in at least one other university, depending on each project
- Small groups of students within each team, to allow high quality supervision, and also for the students to be able to communicate with their peers.
- Presentations at conferences and workshops will be strongly encouraged, as will publication in journals
- Students must learn to communicate effectively: submit at least two research reports + give one presentation annually
- Fundamental research will be supported + encourage industrial participation, both for additional funding, but also to ensure relevant projects for the students. A good balance will be attempted between fundamental and applied research.

PhD Training

- Students registered with one major supervisor (Uni rules!)
- E-mail + visits
- At least 3 reports annually: end May, September and December
- Conferences:
  Discipline specific +
  * African Materials Research Society (AMRS)
  * Microscopy Society of Southern Africa (MSSA)
  * South African Institute of Physics (SAIP)
- AMSEN Meeting alternately with AMRS: Namibia 2010
- Periodic workshops to be attached to AMRS and AMSEN

Networking

- Visits
- Collaborations – build on each other’s
- Web page – build and each node will have a link – CoE-SM, Wits currently building

Communication Plans

- Mostly e-mails
- Visits within Research Teams
- Annual Report: inputs and outputs, progress…
- Short reports from the students
- Publications in journals will be strongly encouraged, as well as making presentations at conferences

Example of a growing Research Team: Corrosion

- Prof. F. Kavishe (Namibia)
- Dr Peter Olubambi (FUTA)
- Prof. L.A. Cornish (Wits)
- Mr J. van der Merwe (Wits)
- …….

Contribution by All Nodes

- Recognized that some institutions have more facilities and expertise than others
- AMSEN will not be allowed to become one-sided
- Guarantee contributions from all nodes by ensuring that the personnel are part of at least some of the research teams
- Where limited expertise, researcher will be mentored.
- Access to equipment not at the home university by visits.
- Recommended, where possible, make applications for travel grants to visit institutions with the necessary equipment.
- All nodes will be encouraged to have active contacts with relevant local industries; will help the less experienced nodes to contribute to the AMSEN network.

Academic Retention Strategy

Note poor remuneration!

Possible remedies:

- Scheme for supplementation from industry
- Allow staff to be seconded to industry for short periods of time
- Allow staff to undertake consulting work
- Reward researchers for papers published and students graduated
- Give academic staff need to be given sufficient time to undertake research
- Support to go to conferences and undertake academic visits
- Funds: equipment, visits and training of the academics involved
- Exposure to other workers…

Possible basis for a reward scheme

Research Unit Values (RUVs) for the different research outputs in AMSEN

Research output	**Research Unit Value (RUV)**	**Rationale and limit**
MSc student in the system	0.5	Up to a limit of 2.5 years
PhD student in the system	1.0	Up to a limit of 5 years
MSc student graduating	1.0	Up to a limit of 2.5 years
PhD student graduating	2.0	Up to a limit of 5 years
Conference paper: abstract at a local conference	0.25	Up to two papers at the same conference
Conference paper: abstract at an international conference, or full paper at a local conference	0.5	Up to two papers at the same conference
Journal paper accepted	1.0	

Research Team	Research Team Members	AMSEN Node	Research Team	Research Team Members	AMSEN Node
Corrosion	Prof. F. Kavishe	UNam	**Composites Research**	Dr J.A. Omotovinbo	FUTA
	Mr J. Van der Merwe	Wits		Dr K.K. Alaneme	FUTA
	Dr Peter Olubambi	FUTA		Prof. R Paskaramoorthy	Wits
	Prof. L.A. Cornish	Wits		Prof. G.O. Rading	U Nairobi
Alloy Development	Prof. G.O. Rading	U. Nairobi		Prof. F. Kavishe	UNam
	Prof. L.A. Cornish	Wits	**Ceramics**	Prof. I. Sigalas	Wits
	Dr N. Sacks	Wits		Prof. J.O. Borode	FUTA
	Prof. F. Kavishe	UNam		Dr J.O.T. Adewara	FUTA
	Prof. J.O. Borode	FUTA		Dr. P.A. Olubambi	FUTA
	Dr B.O. Adewuvi	FUTA		Dr B.O. Adewuvi	FUTA
Phase Diagram Research	Prof. L.A. Cornish	Wits		Prof. P.K. Jain	UBotswana
	Prof. P.K. Jain	UBotswana	**Polymers**	Dr V. Ochieng	U Nairobi
	Prof. M.J. Witcomb	Wits		Prof. G.O. Rading	U Nairobi
	Mr. S.H. Coetzee	UBotswana		Prof. F. Kavishe	UNam
Nanotechnology	Prof. S. lyuke	Wits	**Concrete**	Dr. S. Ekolu	Wits
	Prof. F. Kavishe	UNam		Prof. F. Kavishe	UNam
	Prof. J.O. Borode	FUTA		Prof. G.O. Rading	U Nairobi
	Dr B.O. Adewuvi	FUTA			

Finding students…

- Some universities advertised
- …or word of mouth…
- ... or already had interest / applications

Progress to date!

- 18 students on board, one more identified
- At least 20 faculty members nominated
- Projects already started
- At least 4 conference abstracts submitted

Visits

- Usually try and arrange with other occurrences to save money!
- Visits from RISE
- Visits from other nodes
- Visits to industry

Courses/workshops attended by Wits AMSEN students:

- E- Resources for Engineering Workshop, 25th March, 2009
- Abstract writing 6th May 2009
- Writing a Technical Report for Engineers, 12th March 2009
- Project Proposal, 9th March 2009
- Supervision Practices and Entitlements,18th March, 2009
- Atomic Force Microscopy, 25th 26th March 2009

Progress from Wits

Starting date	Candidate Name	Proposed Research Title	Progress
Jan 2009	Adenike O. Olasiende	Ruthenium additions to the LDX duplex stainless steels	Courses; Exptl. work started + working with post doc on Thermo-Calc; presented at AMI Seminar; abstract sent off to AMRS
Jan 2009	Ayodeja Apata	Study of the V-Ni-C system	Courses; Exptl. work started + working with post doc on Thermo-Calc; abstract sent off to MSSA
Jan 2009	Bernard Odera	The addition of niobium and vanadium to Pt-based superalloys	Courses; Exptl. work started; presented at AMI Seminar; abstract sent off to MSSA
Aug 2009	Adewumi Isaac Popoola	TBA: in computational modelling	Just arrived!

Progress from U. Nairobi

Starting date	Candidate Name	Proposed Research Title	Progress
-	Ms Marina L. Mukabi, Kenya	Development of Electrically conducting polymers	Declined due to problems
1st April 2009	John N. Mwero, Kenya	An Investigation of Sugar Cane Waste Ash as a Cementing Material	Started preliminary experiments
July 2010	Eliakim Niva, Kenya	?	Undertaking necessary course work
Nairobi	Dickson K. Njoroge, Kenya	Proposed: finite element formulation of the behaviour of dislocations in metallic alloys	Working on proposal

Progress from U. Namibia

Starting date	Candidate Name	Research Title	Progress
January 2009	Lloyd Nyemba	Reinforcement of Synthetic Rubber with Carbon Nanoballs to produce Nano-composite Ion Exchange Membrane	Started exptl. work
January 2009	Odilon Ilunga	Thermo-mechanical behaviour of electro-refined blister copper from the Tsumeb Smelter in Namibia	Started, problems with mines not running fully; visited Zambia
January 2009	Graham Bathgate	Continuous production of single-walled carbon nanotubes using swirled floating catalytic chemical vapour deposition	Started exptl. work
January 2010	Willem P. Nashidengo	Study of corrosion along the Namibian coast	….

Progress from FUTA

Starting date	Candidate's Name	Proposed Research Title	Progress
By April 2009	D.O. Folorunso	Sol-gel processing and characterization of naturally-occurring clay materials for refractory application	The candidates have presented their research proposal seminars. With AMSEN funds, they are about sourcing for materials for their research work especially preliminary processing of the raw materials.
By April 2009	F.O. Aramide	Development of alkaline niobate electroceramic from kaolinitic clay materials	
By April 2009	O.O. Olaniran	Development and characterization of nano-structured austempered ductile iron	
By April 2009	I.O. Oladele	Production and evaluation of the mechanical properties of natural fibre reinforced composites	

Progress from U. Botswana

Starting date	Candidate's Name	Proposed Research Title	Progress
August 2009	Stephan H. Coetzee	Constitution of the Ni-Ru-V System	Registered; proposal done; procured furnace and materials; working on journal publication from MPhil & MMSA abstract submitted
August 2009	Cosmos Muiva	Structure and electrical properties of amorphous Se-In-Si films	Registered; started work
August 2009	Gaobakwe Rabalone	An investigation of indigenous clays of Botswana and their influence on the quality of clay products manufactured in Botswana	Registered, proposal in progress
August 2009	Liberty Chipise	A study of the Ni-Ru-Zr System	Registered, proposal in progress

Bursary Grant Committee and
AMSEN Interest Group have been established

Student conferences

- 2 students presented at Advanced Metals Initiative in July 2009
- 3 students have submitted abstracts for Microscopy Society in Southern Africa Conference, Durban, December 2009
- 1 student has submitted an abstract to the African Materials Research Society, Abuja, Nigeria, December 2009
- AMSEN Workshop planned for January 2010

Networking Meetings

- RISE meetings, Nairobi, September 2008 and September 2009
- “Africa Networking Meeting”, Stellenbocsh, October 2008
- Regional and Interregional Cooperation to Strengthen Basic Sciences in Developing Countries Conference, 1st-4th September 2009, Addis Ababa, Ethiopia
- TWAS, Durban, South Africa, October 2009

Problems

- Communication is very difficult at times, especially with Nigeria
- Infrastructure not always good
- Problems with transferring money
- Difficulty in finding administrative staff
- U. Botswana had difficulty in finding students
- University rules!
- Sometimes takes a long time to get the students into the programme!

The future

- Interest from Zambia!
- Work with USA universities on course development
- Increased funding for more liaison

Thank you!

A special thanks to the Carnegie-IAS Regional Initiative in Science and Education for giving us the opportunity