NWU Activities in BRICS and Related Opportunities

BRICS NU ITG on Energy

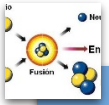
25 June 2020

North-West University

&

University of Limpopo

NWU Strengths on Energy



Nuclear

- Neutronics
- Heat Transfer
- Fluid Flow
- Energy Policy
- AHTRs
- Generation 3&4 Reactors
- Fuel Cycle
- Post Graduate Training

Coal

- Clean Coal
- Power Gx
- Liquid Fuels
- Drying
- Beneficiation
- Stockpile Drainage
- Underground Coal Gasification
- AMD eradication
- Emission

Renewable Energy

- Solar PV
- CSP & Solar Fuels
- Bio-Energy
- Bio Fuels
- Waste to Energy
- Biogas
- HTSA (Solar Fuels)
- Solar Training
- Heat Pumps

Hydrogen

- Production
- Storage
- Distribution
- Fuel Cells
- Electrolysers
- Power to X

Integrated E&EE (Smart Grids & Hybrids)

- Energy Efficiency
- Power quality
- Innovative power systems
- Virtual power grids
- Power to liquids
- Hybrids
- Energy Storage

Fundamental R&D | Application Driven and Integrated Solutions

Intelligent System, Control and Optimization | Training & Education

Material Selection and Design

Simulation, Analyses and Optimization | Environmental Impact

Techno-Economic analyses and Life Cycle Cost Optimization

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NWU Expertise in Energy

- Energy Efficiency (Electrical and Liquid Fuel based)
- Heat Pump R&D
- Solar PV (Rooftop, Grid tied, Remote, Solar car)
- Smart grids and Hybrid Power Solutions
- Energy Storage (Hydrogen, Electrochemical)
- Hydrogen Production, Storage and Distribution (HySA Infrastructure CoC)
- Biofuels, Bioenergy and Waste to Energy
- Coal and Clean Coal R&D (Electricity and Liquid fuel)
- Concentrating Solar Power: Electrical & Process heat
- Simulation, Analyses and Optimization

BRICS RELATED COAL & CLEAN COAL ACTIVITIES

Prof. Quentin Campbell

- Novel game changing coal processing technology almost exclusively comes from China and Russia
- Current Collaboration
  - Corporate member of Coal Preparation Society of India
  - **Coaltech Research NPC (SA)** – testing dry processing technology from China and Russia at pilot scale
  - **BRICS Inter-University Research Group on Coal and Coal Processing** with a strong focus on Clean Coal Technologies.
    - Engaging with various BRICS partners in India, China and Russia.
  - International Organizing Comittee of International Coal Preparation Congress
    - *Networking with Russia, India, China, others*

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Hydrogen R&D

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Hydrogen R&D…

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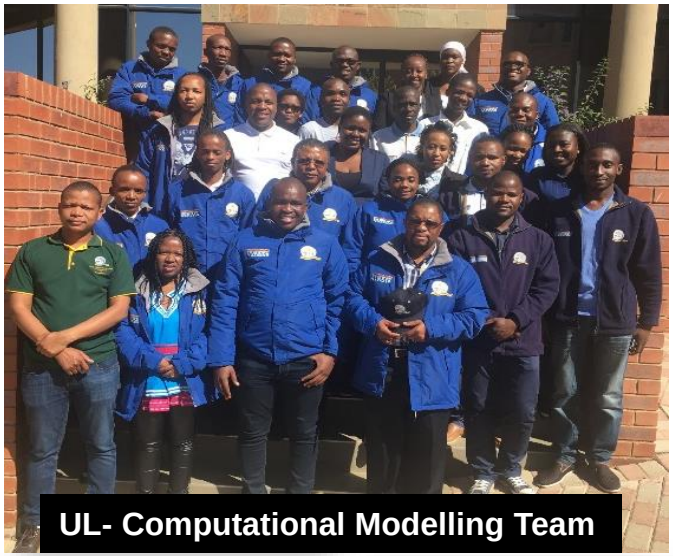
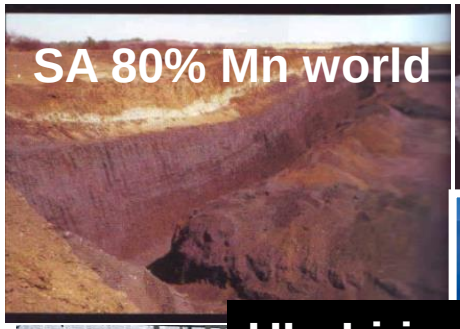
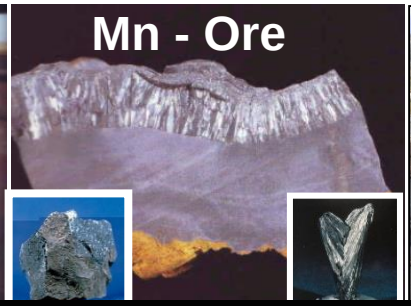
NWU nuclear projects – track record 1999 to 2016

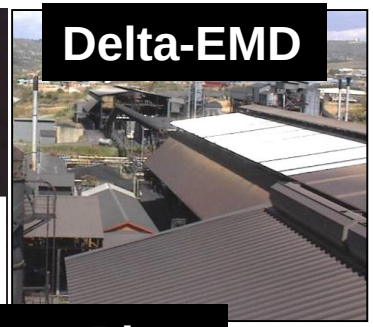
- Designed, commissioned and operated various of nuclear research facilities at NWU since 1999.
  - Pebble Bed Micro model
  - High temperature test unit
  - High pressure test unit
- Distance learning center – fully technology supported system that provides teaching to 30 000+ distance students each year.
- Well established industrial partners specialising in simulation and research facility construction.
- South Africa has launched a RFI for new nuclear power in June 2020.

University of Limpopo – Initiatives: Cathode Precursor


UL- Computational Modelling Team



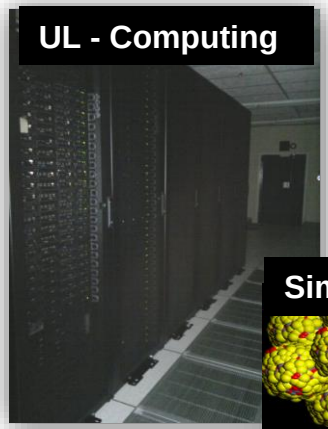




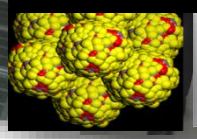
UL: Li-ion Cathode Precursor Plant

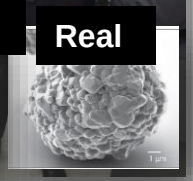

LMO


NMC


UL - Computing


CHPC


Simulated


Real


UL: Cathode Materials/Precursor Team

- CMP Mandate: Development of Cathode Materials Precursor Plant, from minerals, for LIB
- Commissioned the pilot plant
- Production of LMO (14 kg/batch) and NMC (4 L reactor) precursors
- MMC complement - Simulate primary and secondary particles of LMO and NMC


Launch: Pilot Plant Oct 2017

Multi-scale Simulation of Primary Particles

Challenges with Computing Resources

717 801 atoms

24 nm

Simulated primary particles of different sizes

114 184 atoms

13 nm

26 642 atoms

8 nm

(3 332 atoms

4 nm

Simulated aggregation of primary particles to form **secondary particles**

Experimental secondary particle, formed from aggregated primary particles, in a reactor of a cathode precursor pilot plant

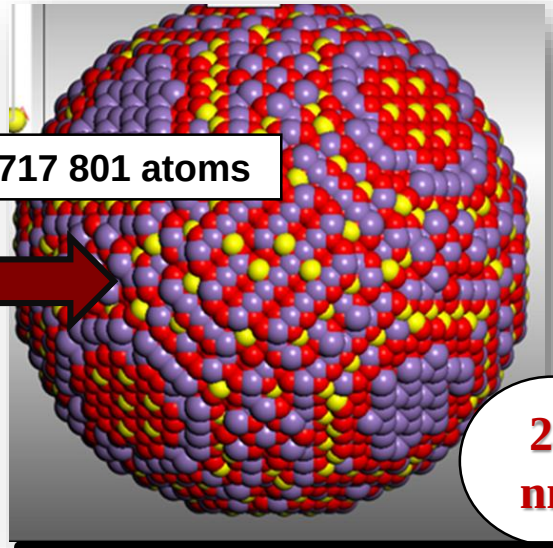
1 µm

Multi-scale Simulation of Primary Particles

SA Team 3rd Place in Cluster Building Competition at International Supercomputing Conference, 25-28 June 2018, Germany

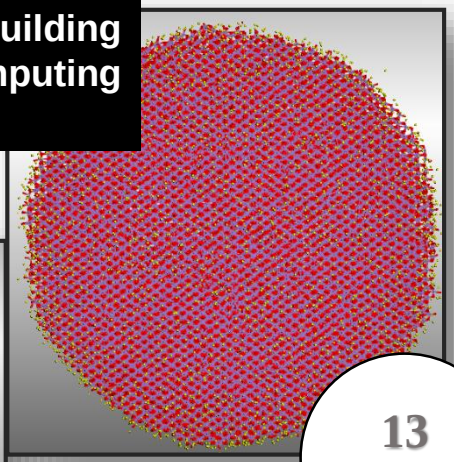
Challenges with Computing Resources

717 801 atoms



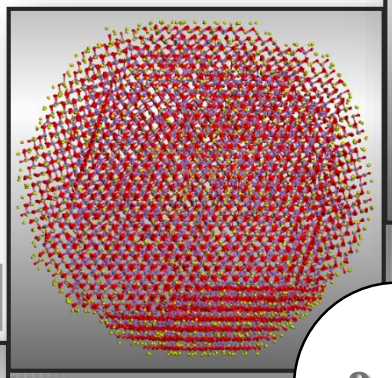
24 nm

114 184 atoms



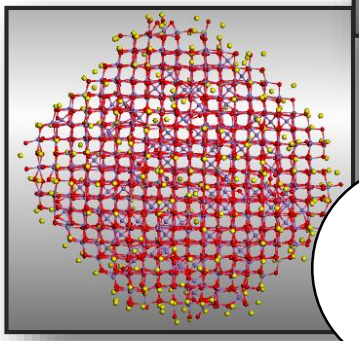
13 nm

26 642 atoms

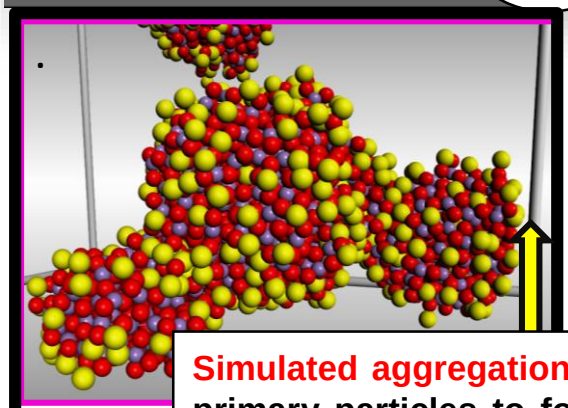


8 nm

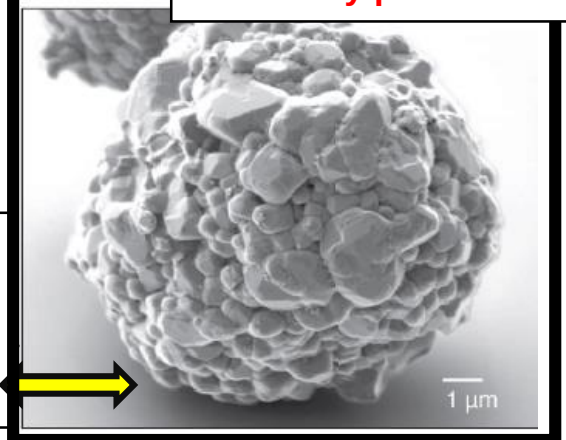
(3 332 atoms



4 nm



Simulated aggregation of primary particles to form secondary particles



Experimental secondary particle, formed from aggregated primary particles, in a reactor of a cathode precursor pilot plant

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