Boitumelo Joyce Matsoso, Ph.D.

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Research Statement

My research focuses on the materials' chemistry of carbon nanotubes (CNTs), graphene and hexagonal boron nitride (*h*BN) for their application in next generation electronic devices. The background of research lies on the modification of these nanomaterials with an aim of varying their morphology, surface, electronic and structural properties to make them suitable for application in energy conversion and storage devices. Various techniques including Raman spectroscopy, transmission electron microscopy, thermal gravimetric analysis, surface area analysis (BET), FT-IR, photoluminescence spectroscopy, UV-visible spectroscopy, TEM, AFM, SEM, PXRD,XPS, cyclic voltammetry (CV), differential pulse voltammetry (DPV), and chronocoulometry were used for morphological, structural and electrochemical analyses.

Work Experience

(a) *15/06/2018- 15/11/2019*- Postdoctoral Fellowship, Laboratoire des Multimatériaux et Interfaces, LMI UMR-5615 CNRS, Université Claude Bernard Lyon 1, France, funded by Graphene Flagship (Work Package 3).

Low temperature synthesis of *h*BN using modified PDCs process

Impact: the work provides a platform for the production of large-scale and high-quality hexagonal boron nitride (*h*BN) single crystals at cost-effective, in terms of lower energy consumption conditions without compromising the physicochemical properties of these *h*BN nanosheets. *The produced nanomaterials are proposed for sensing performance of ammonia and hydrogen gases; work done in collaboration with Dr Jose Serbena in Curitiba, Brazil.*

(b) *15/01/2018- 10/06/2018* – Postdoctoral Fellowship, School of Chemistry, University of the Witwatersrand, South Africa, funded by DST/NRF Mellon Postdoctoral Fellowship.

Effect of doping temperature on physicochemical properties of BN codoped MWCNTs

Impact: Funded and conducted at the University of the Witwatersrand, this work demonstrated that by adjusting the boron and nitrogen (BN) codoping temperature, the optical properties, which are usually difficult to adjust for multiwalled carbon nanotubes (MWCNTs), can be easily tuned. This opened a new window of opportunity for BN-codoped MWCNTs to be used in future generation optoelectronic devices. Presented by an MSc candidate, the work was awarded 1st prize at the National Young Researchers Symposium **(2018).**

(c) *01/08/2012- 30/01/2013* – Research assistant, Water and Sewage Corporation (WASCO), Lesotho

Investigating the durability of untreated and acid-treated clay for purification of industrial waste water

Impact: Funded by the National University of Lesotho, the work was contacted to determine the durability of clay from three different areas in Maseru, Lesotho and the commercial clay for purification of industrial waste-water from Thetsane industrial area.

Education

09/07/2013- 06/11/2017- ***PhD & MSc*** (Chemistry) **–** University of the Witwatersrand, South Africa funded by Johnson Matthey Ltd. Pty, SA

Thesis Title: Synthesis of pristine and doped (N and BN) graphene for electrochemical sensing of dopamine and uric acid.

01/08/2008- 30/08/2013- ***BSc Chemical Technology*** **–** National University of Lesotho, Lesotho

Dissertation Title: *(i)* PEDOT-modified GCE for sensitive selective sensing of dopamine and paracetamol. *(ii)* Investigating the durability of untreated and acid-treated clay for purification of industrial waste water

Conference Presentations

- *Graphene Study 2019, Obergurgl, Austria*-3rd -8th February, 2019.
- *9th International Conference of the African Materials Research Society (AMRS)*, Botswana, 9th- 24 December, 2017.
- *Catalysis Society of South Africa (CATSA) 28th Annual Conference*, South Africa, 19th - 22nd November 2017.
- *South African Nanotechnology Initiative (SANi) National Young Researchers Symposium* - South Africa, 21st October 2017.
- *Johnson Matthey Annual Conference (JMAC)* -, Loughborough, UK, 11th-12th April 2017.
- *6th European conference & exhibition in Graphene and 2D materials*-, Genoa, Italy, 19th-22nd April 2016.

Honors and Awards

15/10/2017- 2nd Prize PhD Oral presentation award, South Africa.
25/11/2016- Best National Young Spectroscopist award, South Africa.
30/03/2016- Postgraduate International travel grants, Wits University
13/0220/16- Graphene 2016 conference Student Travel Grant, Italy.
01/02/2015 – 01/11/2017 - PhD Postgraduate Merit Award, Wits University, South Africa.
24/11/2014- Best Poster presentation, SASS Raman Workshop.

Supervisory/Mentorship Activities

01/02/2018- 01/12/2021 – PhD and MSc, School of Chemistry, University of the Witwatersrand, South Africa

- BN-codoping of few-layer CNTs for organic photovoltaics (OPVs) -> **MSc**
- N-doping of onion-like carbons for OPVs and supercapacitors -> **MSc (2)**
- N-doping of onion-like carbons for sensing of VOCs -> **PhD**

01/07/2017- 01/12/2017 – BSc Honours, School of Chemistry, University of the Witwatersrand, South Africa

- Tuning properties of MWCNTs through controlled BN-codoping

01/07/2016- 01/12/2016 – BSc Honours, School of Chemistry, University of the Witwatersrand, South Africa

- Controlled N-doping of graphene for application in electrochemical biosensors.

Collaboration Project

01/08/2016 -31/07/2020 ***Dr Jose Serbena,*** University of Curitiba, Brazil

- Application of *h*BN and N-doped CNOs in VOCs sensors.

01/02/2018 -31/11/2021 ***Dr Messai Mamo,*** University of Johannesburg, South Africa

- Applications of N-doped CNOs in electrochemical sensors.

01/02/2017 -31/07/2021 ***Prof Daniel Wamwangi,*** University of the Witwatersrand, South Africa

- Synthesis and application of N-doped aligned MWCNTs and C-doped GaN in VOCs, OPVs and FETs.

01/03 -30/11/2017 ***Prof Bonex Mwakikunga,*** DST/CSIR National Centre for Nano-structured materials, South Africa

- Intensive study using Raman spectroscopy to understand the selective adsorption of NH_3 on MWCNTs and blue- and red-shifts of V_2O_5 phonons in NH_3 environment.