

Emerging Nanotechnology Alliance

Photo courtesy - Prof Malik Maaza, UNESCO Chair Nanoscience and Nanotechnology

Foreword

A research university is devoted mainly to research and graduate studies. Johns Hopkins University, established in 1876 was the 1st research university in the U.S. and was modeled after the University of Göttingen in Germany. World War II transformed research universities like the MIT into elite research institutions. Much of this change at MIT was catalyzed by its research centers which impacted the national economy through their spin-offs. A university research center has as purpose to conduct investigations of an interdisciplinary nature, usually with financial support from government agencies, private companies, and other organizations outside of the university. Research centers are unique boundary-spanners providing a degree of flexibility in response to external influences on a university.

CBBR completed its 9th year of existence on 15th December 2020 and aims together with other research centers to catalyze the transformation of

UoM. Similar to World War II, COVID-19 brought in its wake a call for innovative collaboration beyond boundaries. CBBR has joined hands with the United Nations Economic Commission for Africa (UNECA) and Centers on the continent to support Nanotechnology development for the emergence of an Africa Nanotechnology Alliance. Key areas identified during our week-long meeting in December 2020 are Health, Agriculture, Energy, Water and Manufacturing. Africa houses excellent Nanotechnology-oriented researchers and infrastructure. CBBR forms part of this rising Alliance.

Archana Bhaw-Luximon

Contents

- Core technology
- New partnership
- Analytical services, awards and highlight papers
- Community outreach
- Team

Core Technology

Scaffold devices for diabetic wounds healing - 2020 update

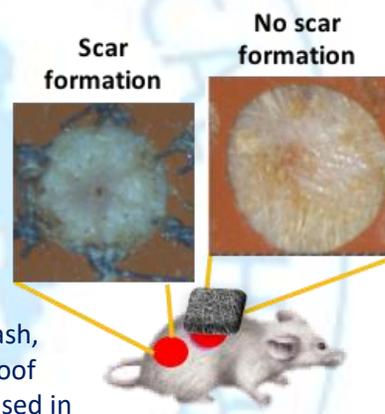
Mauritius ranks 7th in the world for the highest prevalence of diabetes. Currently, about 20% of the Mauritian adult population suffers from diabetes. Diabetic foot ulcers (DFUs) develop because people with diabetes slowly lose feeling in their extremities. Often, these wounds get infected thus increasing tissue damage and eventually leading to amputations. While diabetic wounds usually strike at extremities of the human body, away from the heart and brain, their effects are far-reaching.

Twenty nano-based scaffolds (electrospun mats and hydrogels) fabricated at the BDDN Unit, CBBR were tested for their *in vivo* wound healing properties and non-toxicity. Studies were carried out over a period of 3 weeks at GIP CYROI, Ile de La Réunion. Type 2 diabetes was chemically induced in Wistar rats via intra-peritoneal injection of streptozotocin. This injection destroys the β -cells in the islets of Langerhans of the pancreas. Compared to a non-treated wound and a wound treated with a commercial product, wounds treated with nanoscaffolds accelerated wound healing and resulted in contractionless and scarless wound closure.

Materials transformation - Bio-economy

The Biomaterials, Drug Delivery and Nanotechnology Unit (previously the Polymer Group at the Department of Chemistry) has been working for the past 25 years on biopolymers from our land and marine resources. The unit has explored a range of materials such as sucrose and lactic acid from sugar, cellulose from sugar-cane bagasse and green seaweeds, fucoidans and carrageenans from brown and red seaweeds, collagen from fish skin/fins, nanosilica from bagasse ash, hydroxyapatite from seaweeds etc. These materials have completed proof-of-concept feasibility and most of them are being re-engineered and used in nanodevices.

The Unit is now ready to explore the pilot scaling exploitation of these biomaterials with partners in view of contributing to a Mauritian Bio-economy. The development of our Bio-economy will accelerate progress towards a circular and low carbon economy.



Opportunities for Nutraceuticals Development from Our Local Resources

The Biopharmaceuticals Unit recently completed a consultancy work for the Economic Development Board (EDB) along with the Faculty of Agriculture on the “Development of a Nutraceutical Framework and Industry in Mauritius”. The work aimed at drafting a clear roadmap, which will chart the way for the private sector to engage into large-scale production of nutraceuticals. The main conclusion involved the identification of 126 terrestrial and marine organisms with nutraceutical potential with a recommendation of 7 plants that would yield high return on investment, namely: Moringa, Papaya, Strawberry, Guava, Tea, Pineapple, Pomegranate and Noni. Land analysis for large-scale production of nutraceutical plant species has also been undertaken and a user-friendly database with relevant information for the nutraceutical business has been created and is currently hosted by the EDB.



New Partnerships

RT Knits Ltd and CBBR taking up the Science and Engineering challenge

There is a need to produce masks locally/regionally and reduce dependency on imports particularly during times of pandemic when supply chains are disrupted. Most often, imported masks are non-washable and their disposal is a health and environmental hazard. Existing face masks fail to maintain their air filtering function because their electrostatic function disappears when exposed to water. Current protective masks are not sustainable as non-reusable and non-recyclable, and are not designed to kill the bacteria/virus entrapped within their structures.

CBBR and RT Knits have been selected as UNECA awardee for the Nanotech Mask at the UNECA Nanotechnology Innovation and Investment Forum, 18 December 2020.

The development of a home-grown technology for Africa has thus been recognized on the continent.



African Materials Research Society (AMRS)

Through the AMRS collaboration, three members of the BDDN Unit have participated in the prestigious Materials Research Society of Singapore (MRS-S) 9th MRS-S Conference on Advanced Materials on 25-27 November 2020. This biennial series bring together the materials community in Singapore for sharing and discourse across 5 different research themes - Characterization, Modelling & Theory, Energy Materials & Technologies, Electronic & Photonic Materials, Soft Materials & Biomaterials and New Frontiers in Materials Research.



Dr Nowsheen Goonoo
Research Fellow – L'Oreal funded
'Piezoelectric nano-scaffolds for skin repair: reduced in vivo superficial wound contraction and scarless tissue regeneration'



Dr Itisha Chummun
Postdoc Research Assistant– Pole of Innovation for health MRIC-EU funded
'In situ injectable polysucrose-based hydrogel promotes scarless wound healing in Wistar rats'



Mr Devesh Bekah
Research Assistant– Pole of Innovation for health MRIC-EU funded
'Nanoparticle-Loaded Hydrogels or Electrospun Mats to Enhance Scaffold Performance in Wound Healing'

United Nations Economic Commission for Africa (UNECA)

Nanotechnology is increasingly recognized as a platform technology that could play an important role in the efforts of African countries to achieve the targets of the SDGs and realize the aspirations of the African Union's Agenda 2063. UNECA has compiled a report entitled 'Towards an African nanotechnology future - Trends, impacts and opportunities' in April 2020. The report provides an assessment of the current state of nanotechnology in Africa as well as provides an overview of nanotechnology development globally and explores opportunities to enable innovation. CBBR has contributed to the UNECA report.

Analytical Services

Services through High-end Analytical Facilities – Tools Filling the Gap in Industry portfolio

- **Labscale and Pilot Line Inovenso electrospinning machines**
Nanofibers, electrospinning, coating
- **Tescan Scanning Transmission Electron Microscope/EDX**
Imaging and sizing of structures, Composition of materials
- **Universal Instron Mechanical tester – compression and stretching** Mechanical properties of devices, materials, PPE etc
- **Netzsch Thermal analyzers**
Thermal properties & purity of materials
- **Brookhaven Particle Size analyzer**
Determination of size of particles
- **Kruss Drop Shape Analyzer**
Hydrophilicity/hydrophobicity of surfaces
- **Diener Plasma System**
Surface modification, sterilization
- **Fully equipped Bio Lab for in vitro testing**
Fluorescence microscope, Ultra low freezer, Low temperature Centrifuge, CO₂ and CO₂/N₂ incubators, Microplate reader, Autoclave, Nitrogen tanks, Cell lines, Biosafety Level 2 hoods, Tissue lyser
- **Equipped Chemistry Lab**
- **Access to Local & International partner Labs**
- **Access to expert network**



Pilot line Nanospinner Mechanical testing



Scanning Electron Micro. Fluorescence Micro



Bio Lab Surface analysis

Awardees



Ms Koushane Madub, MPhil/PhD student, BDDN Unit, was selected for the ‘**Jeunes Talents Scientifiques Africains d’Universcience 2020**’ to represent Mauritius. The event brings together 47 young African scientific talents from 26 African countries encouraging discussion on the scientific mediation in Africa and France. It regroups two large Science Centers in Paris: la Cité des sciences et de l’industrie and le Palais de la découverte.

Dr Itisha Chummun was selected for 1st virtual **British Society for Nanomedicine** Early Career Research Meeting chaired by Professor Steve Colan and Tom McDonald. She was selected to be part of the 16 panelists for the event which is an opportunity for Early Career Researchers to showcase their work and discuss with experts in the field of nanomedicine. She is now a member of the BSNM.

Ms Piteesha Ramlagan, PhD student, Biopharmaceuticals Unit, won the 3rd prize at the 3rd Edition of the Mauritius Research and Innovation Council Post-Graduate Conference held in October 2020.

Highlight Recent Publications

- Avin Ramanjooloo, Raymond J Andersen, Archana Bhaw-Luximon, **Marine sponge derived/inspired drugs and their applications in drug delivery systems**, Future Medicinal Chemistry, 2020 in press.

Collaboration bringing together the expertise of Prof Raymond Andersen, natural product chemistry expert at the University of British Columbia, Canada, and BDDN Unit’s expertise in nanodrug delivery systems. Avin is an Associate Research Scientist at MOI and doing his MPhil/PhD at the BDDN Unit.

- Nawraj Rummun, Philippe Rondeau, Emmanuel Bourdon et al. Terminalia bentzoë, a Mascarene Endemic Plant, Inhibits Human Hepatocellular Carcinoma Cells Growth In Vitro via G0/G1 Phase Cell Cycle Arrest. Pharmaceuticals, 2020, 13(10), 303. <https://doi.org/10.3390/ph13100303>

Highlights Community Outreach and Talks

The younger generation of researchers at CBBR (PostDocs, PhDs, RAs) are fully involved in community outreach activities and act as role models contributing towards our science capital.

British Council - Women in STEM (Ada Lovelace Day 2020) & UK Alumni Award



Guided tour of BDDN Unit for British Council and Northfields International School students, focused on research on nanotechnology, 19 October 2020.

<https://www.facebook.com/BritishCouncilMauritius/posts/3666743920013929>

Supporting STEM Education



Interactive visit of MGI Moka Grade 13 Science students to BDDN Unit, 29 September 2021 organized by the Career's Guidance Unit, Ministry of Labour, Human Resource Development and Training.

Diabetes day – Community Outreach



The BDDN Unit participated in the University of Mauritius-La Clinique Mauricienne Diabetes Day Programme, organized by Dr Jodheea-Jutton, 20 November 2020.

National Science Week



Biopharmaceutical Unit participated in the National Science Week on plant health, 2-4 December 2020 at the Rajiv Gandhi Science Center.

- **UNECA Nanotechnology Innovation and Investment Forum, 14-18 December 2020**

Dr Archana Bhaw-Luximon

14 Dec – Keynote: Showcasing of nanotechnology research, innovation and industrial infrastructure in Africa

15 Dec – Joint Presentation with RT Knits Ltd: Masks incorporating nanofiber layers acting as filtration membranes

18 Dec – Chair: High Level Panel on Nanotechnology Strategies for the Future

- **4th International Pharma Conference, 18-19 November 2020**

Rethinking the scope of biodiversity in biomedicine and nutraceuticals development within Africa in the post COVID era, Keynote- Dr Vidushi Neergheen



Congratulations

Ms Khajal Beetun, Executive Assistant, CBBR has successfully completed the HSK2 Mandarin course offered by Confucius Institute, UoM.

Researchers

Biomaterials Drug Delivery and Nanotechnology (BDDN) Unit

Dr Archana Bhaw-Luximon (Head CBBR)

Dr Nowsheen Goonoo (L'Oreal funded Research Fellow)

Dr Itisha Chummun (PostDoc RA, Pole of Innovation for Health MRIC-EU funded)

Mr Devesh Bekah (PhD completed, RA, Pole of Innovation for Health MRIC-EU funded)

Mr Chandrodhay Saccaram (MSc, RA Covid-19 project, CBBR-MRIC-RT Knits Ltd funded)

Ms Koushanee Madub (HEC funded MPhil/PhD and Fellowship)

Dr Abha Jodheea-Jutton (Medical Doctor, HEC funded MPhil/PhD)

Mr Avin Ramanjooloo (MSc, HEC funded MPhil/PhD and Fellowship)

Mr Akash Nundloll (MChem, Pole of Innov MPhil/PhD, MRIC funded)

Ms Lakshmi Sujeeun (MSc, Pole of Innov MPhil/PhD, MRIC funded)

Funding



CYROI, La Réunion, Pre-Clinical Trials Team

Dr Fanny Gimié (Veterinary and President Ethics Committee, La Réunion)

Dr Colette Cordonin (Biochemist)

Mr Imade Ait Arsa (Biochemist engineer)

Industry Collaborator

Mr Kendall Tang, CEO RT Knits Ltd – Specialty Textiles

Biopharmaceuticals Unit

Dr Vidushi Neergheen

Ms Annaelle Hip Kam (MPhil/PhD)

Mrs Kalundini Huldarowa Paudel (RA)

PhD Submitted: Ms Tatsha Bholah (March 2020), Mr Nawraj Rummun (June 2020), Ms Piteesha Ramlagan (June 2020)

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Contact us

CBBR Building, MSIRI, Réduit, Mauritius

Dr Archana Bhaw-Luximon, Head, CBBR – 230 - 4643781

Ms Khajal Beetun (Executive Assistant) – 230 - 4548722

Email: a.luximon@uom.ac.mu, abluximon@gmail.com

