

Postdoctoral Fellowship

Project Title:

Modelling of ionic transport and fluid flow in hydrogels with encapsulated particles.

We are seeking a Postdoctoral Research Associate (PDRA) with a strong background in theoretical/computational soft matter to work on a collaborative project between Stellenbosch University, Embu University, Dedan Kimathi University of Technology, University of Edinburgh, and Durham University.

Scope of Research:

Soil acidification is an urgent and escalating barrier to agricultural productivity in sub-Saharan Africa (SSA). Climate change amplifies nutrient leaching and the accumulation of toxic ions, which degrade soil structure, reduce water retention, and inhibit root growth. Over 35 % of SSA's cropland (>350 million hectares) is acid-affected, especially in East, Central, and Southern Africa. This project entails a physics-driven design and evaluation of composite particles: dolomite microparticles encapsulated in a bio-polymeric matrix. The central challenge is to control the spatial and temporal release of liming ions under realistic soil and weather conditions.

Key soft matter themes in this project include:

- Moisture retention: leveraging polymer physics to link network structure, tortuosity, and water-holding;
- Ion transport & reaction: using reaction-diffusion and fluid dynamics to capture ion release, swelling, and internal reactions;
- Soil coupling: applying granular physics and capillarity to model fluid flow, particle rearrangements, and ion transport interactions.

The modelling PDRA is expected to develop theoretical models and computer simulations based on lattice Boltzmann method to better understand the interplay between ionic transport, fluid flow, and soil particle dynamics as part of a multi-disciplinary team. The PDRA is also expected to interact effectively with two experimental PDRAs to optimise the design and controlled release of the composite particles.

The PDRA will work under the supervision of Prof Kristian Müller-Nedebock (Stellenbosch University) and Prof Halim Kusumaatmaja (University of Edinburgh). The PDRA will be mainly based at Stellenbosch University and is expected to spend ~3 months in the UK as part of the project. There is also parallel recruitment for 2 experimental PDRAs to be based at Embu University and Dedan Kimathi University of Technology in collaboration with Durham University.

Host:

Prof. Kristian Müller-Nedebock
Department of Physics
Stellenbosch University
E-Mail: kkmn@sun.ac.za

Requirements:

- A good undergraduate degree and a **PhD in physics, applied mathematics, engineering, or a clearly related area.**
- Proven track record of **theoretical and/or computational research in soft matter and/or fluid dynamics.**
- Demonstrable **experience** in employing theory and simulations to generate new physical insights in soft matter and/or fluid dynamics.
- Experience in delivering research project results; i.e. a **record of peer-reviewed high impact journal and conference papers** in a relevant area.
- Capable of working collaboratively with researchers from different disciplines or technical background.
- Capable of working independently, exercising a high degree of initiative and demonstrating a pro-active and flexible approach to work.
- Good communication skills; oral, writing and presentation of data.
- Ability to contribute ideas and initiate new ways of working.

Preferable Criteria:

- Ability to be adaptive and to cross-fertilise concepts in different areas of research.
- Specialist knowledge in polymer physics, fluid mechanics, mechanics/elasticity, and/or capillarity.
- Strong knowledge in relevant computational fluid dynamics/soft matter methods.

Starting date: 1 April 2026

Application deadline: 10 March 2026

Application procedure:

Please send a letter of application (including the reasons why you are qualified for the position), a curriculum vitae (CV), including a list of publications, and the names and contact details of at least two referees to kkmn@sun.ac.za.

Applicants should request their referees to forward confidential letters of reference directly to the same e-mail address by the closing date.

Notes:

- Postdoctoral research associates are not appointed as employees. Therefore, they are not eligible for employee benefits.
- The contract is for two years. This will be subject to the availability of funds and satisfactory progress (annual performance reviews must be held).