

Editorial

# Preface: Micro Manufacturing Convergence Conference <sup>†</sup>

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<sup>†</sup> All proceeding papers published in this volume were presented at the Micro Manufacturing Convergence Conference, Stellenbosch, South Africa, 7–9 July 2024.

## 1. Introduction

The Micro Manufacturing Convergence Conference 2024 (MMC 2024) is hosted by Stellenbosch University's Department of Electrical and Electronic Engineering, in partnership with the Department of Science and Innovation (DSI) and the Nano-Micro Manufacturing Facility (NMMF). The conference Chair is Prof. Willie Perold.

The conference aims to bring together global experts, researchers, and innovators to explore cutting-edge developments in sensor technology and nano/micro manufacturing. Topics include the following:

- Printed electronics;
- Electrochemical sensors;
- Paper-based diagnostics;
- Lab-on-a-chip;
- Biosensors;
- Nanomedicine;
- Smart agriculture sensors.

MMC 2024 will serve as a platform for knowledge exchange, collaboration, and networking across disciplines like biology, electronics, chemistry, and manufacturing. Attendees will gain insights into how convergent technologies are accelerating innovation and commercialization.

## 2. Committee Members

### 2.1. Organizing Committee

Prof. Willie Perold, Stellenbosch University (Chair);  
Dr. Manfred Scriba, Council for Scientific and Industrial Research (CSIR);  
Prof. Trudi-Heleen Joubert, University of Pretoria;  
Mr. Daniël Retief, Stellenbosch University;  
Mr. Kennedy Madufor, Stellenbosch University.

### 2.2. Scientific Committee

Prof. Willie Perold, Stellenbosch University (Chair);  
Dr. Manfred Scriba, Council for Scientific and Industrial Research (CSIR);  
Prof. Trudi-Heleen Joubert, University of Pretoria.

## 3. Keynote Speakers

Dr. Manfred Scriba, Council for Scientific and Industrial Research (CSIR);  
Prof. Uli Lemmer, Karlsruhe School of Optics & Photonics, Germany;



Published: 4 September 2025

**Citation:** Perold, W. Preface: Micro Manufacturing Convergence Conference. *Eng. Proc.* **2025**, *109*, 2. <https://doi.org/10.3390/engproc2025109002>

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Dr. Kevin Land, Centre for Advanced Rapid Diagnostics, the United Kingdom;  
 Prof. Resia Pretorius, Stellenbosch University;  
 Prof. Linus Opara, Stellenbosch University;  
 Prof. Anna-Mart Engelbrecht, Stellenbosch University;  
 Dr. Sanjeev Rambharose, Stellenbosch University.

#### 4. Program

##### Day 0: 7 July 2024

5:00 p.m.–6:30 p.m.: Shuttle

6:40 p.m.–9:30 p.m.: Gala Dinner at La Pineta

9:40 p.m.–10:40 p.m.: Shuttle back

##### Day 1: 8 July 2024

8:30 a.m.–9:30 a.m.: Registration/Coffee

**9:30 a.m.–10:30 a.m.: Session 1—Opening addresses** (Chair: W.J. Perold)

- Welcome: Prof. Willie Perold (Chair: Organising Committee) [5 min]
- Overview of the Nano-Micro Manufacturing Facility (NMMF): Dr. Manfred Scriba [25 min]
- Address by Prof. Sibusiso Moyo, Deputy Vice-Chancellor: Research, Innovation and Postgraduate Studies, Stellenbosch University [10 min]
- Capabilities of NMMF nodes: Node Directors [20 min]

**10:30 a.m.–11:00 a.m.: Tea break**

**11:00 a.m.–12:30 p.m.: Session 2—Printed Electronics** (Chair: T-H. Joubert)

- Plenary Speaker: Prof. Uli Lemmer [30 min]
- Presentation 1: [15 min]

*“Stack printing for the production of carbon screen printed electrodes based on conductive silver paste on flexible substrates”, R. L. Dreyer; T. N. Moeketse and P.G. Baker (University of the Western Cape, South Africa).*

- Presentation 2: [15 min]

*“In-plane thermoelectric characterisation of PEDOT:PSS films with inkjet-printed test structures”, P. N. Msomi and T-H. Joubert (University of Pretoria, South Africa).*

- Presentation 3: [15 min]

*“Color selective inkjet-printed photosensitive organic field effect transistors”, C. Steger, C. Rainer, O. Karakaya, A. Tunc, D. Mager, T-H. Joubert and G. Hernandez-Sosa (University of Pretoria, South Africa).*

- Presentation 4: [15 min]

*“Design and development of electrochemical biosensing platforms by prototyping biomedical devices on flexible substrates through stacked screen printing”, T. N. Moeketse, P. R. Makgwane and P. G. Baker (University of the Western, Cape, South Africa).*

**12:30 p.m.–1:30 p.m.: Lunch break**

**1:30 p.m.–3:00 p.m.: Session 3—Lab-on-a Chip/Paper-based Diagnostics** (Chair: P. Baker)

- Plenary Speaker: Dr. Kevin Land [30 min]
- Presentation 1: [15 min]

*“Developing a simple automated method to measure a T cell-based TB biomarker”, M. Musvosvi, S. Motimele, T. Bvudzijena, M. Fisher; T. Scriba, S. Barth (University of*

Cape Town, South Africa), N. J. Madufor; D.J Retief, and W.J. Perold (Stellenbosch University, South Africa).

- Presentation 2: [15 min]  
*“Rapid routes to Lab-on-a-Chip (LOC) prototype fabrication”*, **M. Scriba**; M. Kakaza and E. Maesela (CSIR, South Africa).
- Presentation 3: [15 min]  
*“Challenges in the generation, evaluation and application of aptamers in paper-based diagnostics”*, **J. Limson**, R. Fogel (Rhodes University, South Africa).
- Presentation 4: [15 min]  
*“Development of a nano- and microfiber mesh-based biosensor for the rapid quantification of human C-reactive protein (CRP)”*, **A.M. Lloyd**, P.R. Fourie and W.J. Perold (Stellenbosch University, South Africa).

**3:00 p.m.–3:30 p.m.: Coffee break**

**3:30 p.m.–5:00 p.m.: Session 4—Nanomedicine** (Chair: J. Limson)

- Plenary Speaker: Dr. Sanjeev Rambharose [30 min]
- Presentation 1: [15 min]  
*“Innoeco Lab Solutions: a novel micro-factory for nanomedicine synthesis”*, **M. H. Dasram**, P. Naidoo (Innoeco Lab Solutions, South Africa).
- Presentation 2: [15 min]  
*“Engineering carbon nanotubes as therapeutic nanocarriers of *Tulbaghia violacea*, *Annona muricata*; *Dicoma capensis* and *Dodonaea Viscosa* plant-based extracts; targeting breast and colorectal cancer”*, **Z. T. Gwanzura**, A-M. Engelbrecht, W. J Perold (Stellenbosch University, South Africa).
- Presentation 3: [15 min]  
*“Nanoparticle-mediated drug delivery: enhancing therapeutic efficacy and minimizing toxicity”*, **A. W. Gitungo** (Pharmaceutical Society of Kenya, Kenya). (ONLINE PRESENTATION)

**Day 2: 9 July 2024**

8:30 a.m.–9:00 a.m.: Coffee

**9:00 a.m.–10:30 a.m.: Session 5—Sensors in Smart Agriculture** (Chair: V. Mandiwana)

- Plenary Speaker: Prof. Linus Opara [30 min]
- Presentation 1: [15 min]  
*“Development and evaluation of an electrochemical DNA based magnetic nanoparticle biosensor for detecting the fungal pathogen *Fusarium oxysporum f. sp. Cubense*”*, **U. N. Akwuruoha**, D. Mostert and W.J. Perold (Stellenbosch University, South Africa).
- Presentation 2: [15 min]  
*“Paired emitter detector diode array for colourimetric detection of water treatment chemicals”*, **D. Olivier** and T-H. Joubert (University of Pretoria, South Africa).
- Presentation 3: [15 min]  
*“Development of a low-cost heating system for DNA amplification: A novel approach to RPA amplification and *Fusarium Wilt* detection”*, **N. J. Madufor**, D. Mostert and W. J. Perold (Stellenbosch University, South Africa).
- Presentation 4: [15 min]

*“Addressing manufacturing and cost challenges toward solving low-cost in situ digital holographic microscopy problems”*, **L. Hurter**, J. Schoeman and H. Laue (University of Pretoria, South Africa). (ONLINE PRESENTATION)

**10:30 a.m.–11:00 a.m.: Tea break**

**11:00 a.m.–12:30 p.m.: Session 6—Biosensors** (Chair: W. J. Perold)

- Plenary Speaker: Prof. Resia Pretorius [30 min]
- Presentation 1: [15 min]

*“CSIR Human Diagnostic Platform: A case study into the Development of an Africa Lateral-flow assay-based Early Recognition Test for Tenofovir-induced Acute Kidney Injury (ALERT-AKI)”*, **A. Skepu**, N. Nxumalo and K. Polori (CSIR, South Africa). (ONLINE PRESENTATION)

- Presentation 2: [15 min]

*“Comparison of fluorescent and colorimetric stains for monitoring key parameters of biofilm growth”*, **M. Davies**, R. Fogel and J. Limson (Rhodes University, South Africa).

- Presentation 3: [15 min]

*“Towards a wearable skin tone responsive photoplethysmography sensor”*, **N. Ndiweni** and T-H. Joubert (University of Pretoria, South Africa).

- Presentation 4: [15 min]

*“Silicon photonic PSA immunosensor—synthesis, characterization, and application”*, **T. A. Okhai**, A. O. Idris, U. Feleni and L. W. Snyman (Tshwane University of Technology, South Africa). (ONLINE PRESENTATION)

**12:30 p.m.–1:30 p.m.: Lunch break**

**1:30 p.m.–3:00 p.m.: Session 7—General sensor applications** (Chair: M. Scriba)

- Plenary Speaker: Prof. Anna-Mart Engelbrecht [30 min]
- Presentation 1: [15 min]

*“Development of a plasmonic based biosensor to assist in the diagnosis of anxiety and depression”*, **Z. Tayob**, G. Bosman, W. J. Perold and A-M. Engelbrecht (Stellenbosch University, South Africa).

- Presentation 2: [15 min]

*“Empowering visual impairedness with AI-Enhanced footwear”*, **S. K. Shitanda**, O. Onyango and D. Maithya (Nairobi, Kenya). (ONLINE PRESENTATION)

- Presentation 3: [15 min]

*“A sensing system based on digital loop-mediated isothermal amplification on a track-etched membrane”*, **L. Blignaut**, A. M. Engelbrecht and W. J. Perold (Stellenbosch University, South Africa).

- Presentation 4: [15 min]

*“Green synthesis, characterisation, and anticancer activity of gold nanoparticles using *Dodonaea viscosa* as a reducing agent”*, **N. Reddy**, A. M. Engelbrecht and W. J. Perold (Stellenbosch University, South Africa).

**3:00 p.m.–3:30 p.m.: Coffee break**

**3:30 p.m.–5:00 p.m.: Session 8—Forum discussion** (Chair: M. Scriba)

- Presentation 1: [15 min]

*“Nanoparticle-mediated drug delivery: enhancing therapeutic efficacy and minimizing toxicity”*, **A. W. Gitungo** (Pharmaceutical Society of Kenya, Kenya). (ONLINE PRESENTATION)

- Presentation 2: [15 min]

*“Development of a nano- and microfiber mesh-based biosensor for the rapid quantification of human C-reactive protein (CRP)”*, **A.M. Lloyd**, P.R. Fourie and W.J. Perold (Stellenbosch University, South Africa).

- Open discussion

**5:30 p.m.–8:30 p.m.: Cocktail Evening**

#### **POSTER PRESENTATIONS**

1. *“Glucose biosensor”*, T.N. Gwanzura.
2. *“A Drone-operated Biosensor to Determine Water Quality On-site and in Real-time”*, N. Jiri, W. J. Perold, L. M. T. Dicks, D. Hurn, K.B. Hoorzook, Y. van Wyk.
3. *“Development of biosensor for the early detection of tuberculosis meningitis in infants”*, D. Kim, W.J. Perold, N. Chegou.
4. *“Surface Plasmon Resonance: Transfer Matrix Method (TMM) simulations and Finite Element Method (FEM) with COMSOL simulations”*, H. V. Jacobs, W.J. Perold, G. W. Bosman.
5. *“Development of a low-cost disposable and bio-degradable E. coli detection device”*, V. Mandiwana.
6. *“NGS-Guided aptamer Re-selection for improved sensor applications”*, T. Singh, R. Fogel, J. Limson.
7. *“Data analysis and modelling of a sodium salt matrix with low-cost impedance spectroscopy”*, D. J. de Beer, T-H. Joubert.
8. *“Veterinary blood oxygen saturation detection”*, K. Mpala, T-H. Joubert.
9. *“Development of a microfluidic liquid dispensing systems for LOC’s”*, M. Kakaza.
10. *“Low-cost fabrication of multilayer PDMS based Lab-on-Chip devices”*, E. Maesela.
11. *“Low-cost paper-based DNA and RNA extraction dipstick to isolate CircRNA cancer biomarkers”*, S. Rutherford, R. Fogel, J. Limson.
12. *“Microfabrication of an e-QR code sensor display on a flexible substrate”*, A. E. Raju, H. E. A. Laue, T-H. Joubert.
13. *“Opportunities and challenges of printed environmental sensors”*, G. Maina.
14. *“Printed electronics”*, A. M. Mwendwa.
15. *“Geotto ecosystem—A sustainable Hatchery system powered by geothermal energy”*, D. Kata.

#### **5. Sponsors**

Department of Science and Innovation (DSI);  
Nano-Micro Manufacturing Facility (NMMF).

**Conflicts of Interest:** The author declares no conflicts of interest.

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