



Stellenbosch
UNIVERSITY
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Engineering
EyobuNjineli
Ingenieurswese



Electrifying Biology: From Concepts to Cutting-Edge Sensors

Dr Taskeen Ebrahim – Electrical and Electronic Engineering

Faculty of Engineering

Industry Showcase 2025

SAND Research Group and NMMF



SAND

Sensor Application and Nano Devices



nano-micro
manufacturing
facility

nmmf.co.za

**Director of Biosensors Node, hosted at
Stellenbosch University:**

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Lab manager:

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Why biosensing?

- Used in medical diagnostics, environmental monitoring, food safety, and biosecurity.
- Reduces the need for expensive laboratory tests, making healthcare more accessible.
- Can detect low concentrations of analytes with high precision, ensuring accurate diagnostics.
- Provides real-time data, allowing for timely interventions and adjustments in treatment plans.
- Possibility of continuously tracking health indicators without invasive procedures.

Common Commercial Sensors



Glucometer



Pregnancy tests



Drug panel

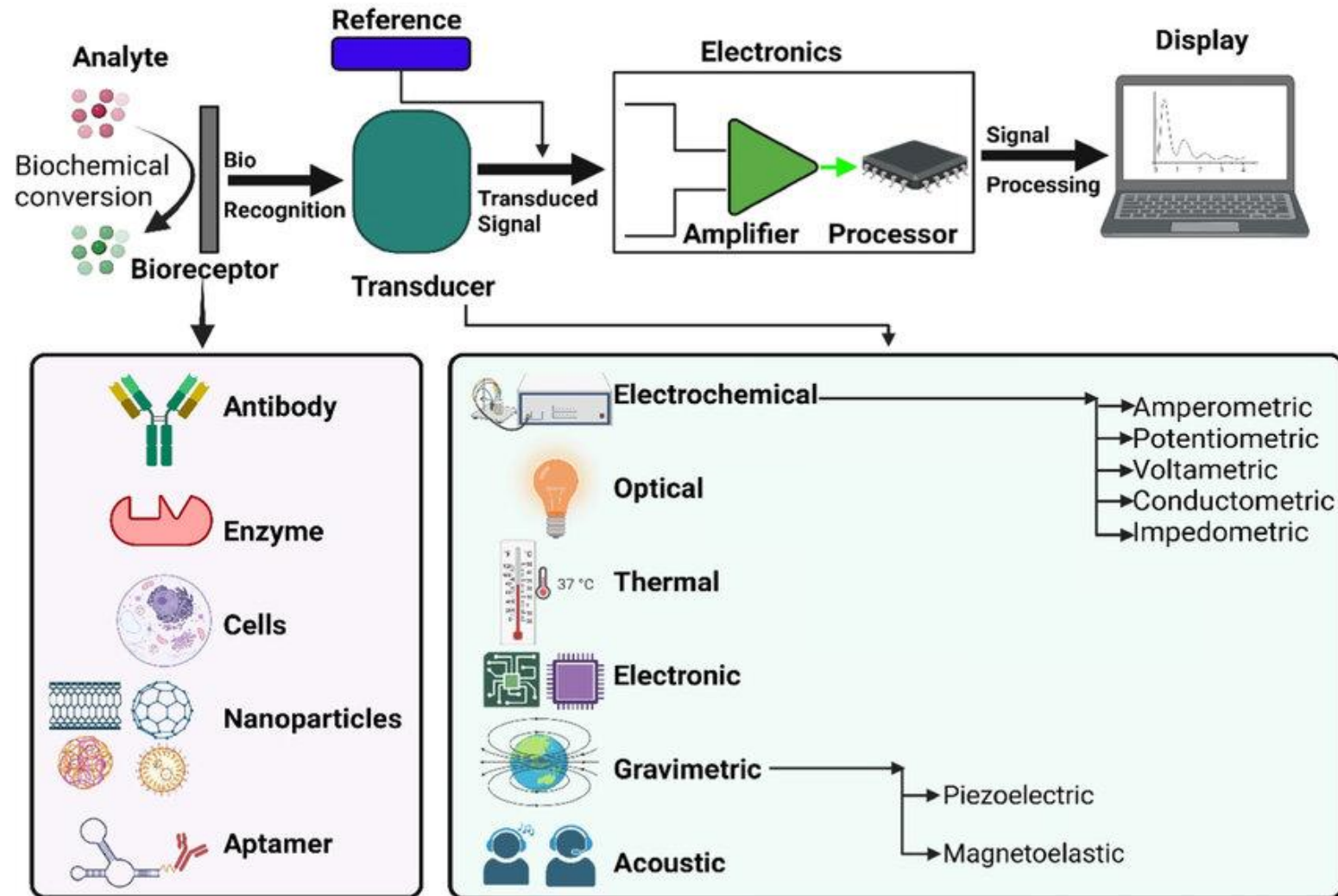


COVID Ag tests

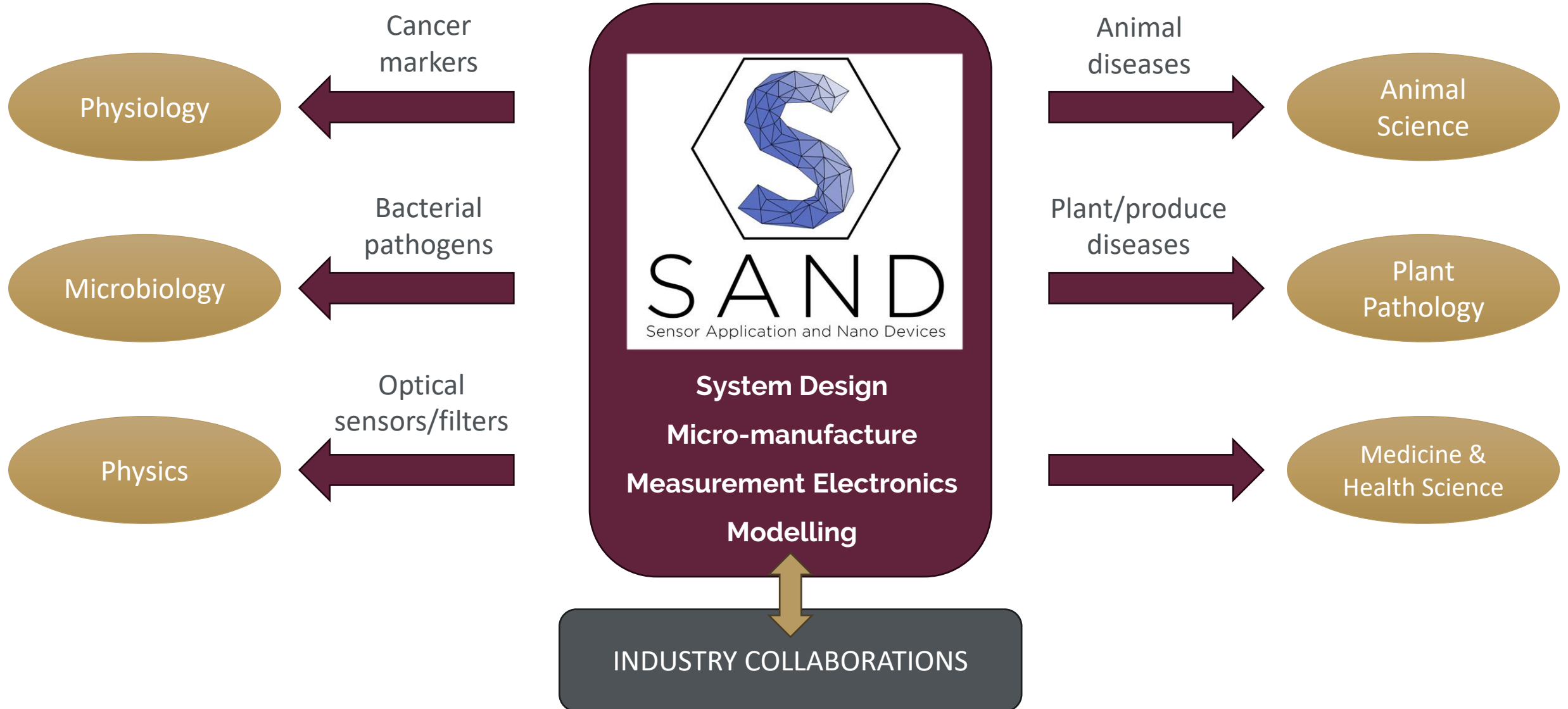


Breathalyzer

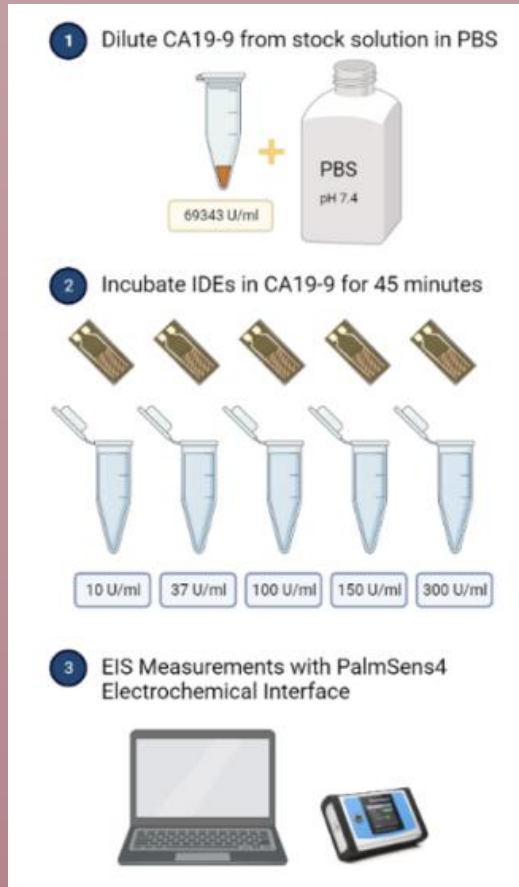
What is a biosensor?



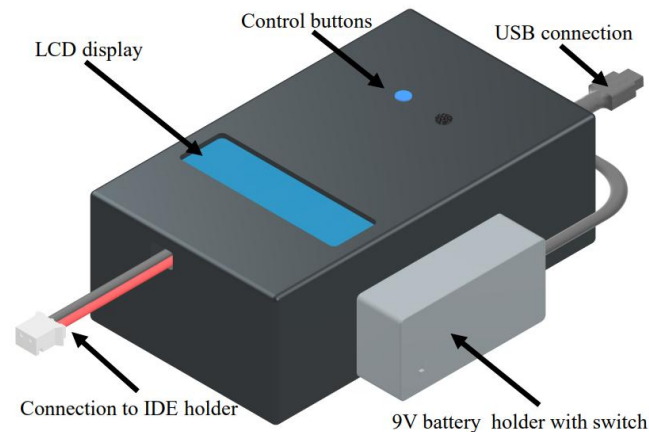
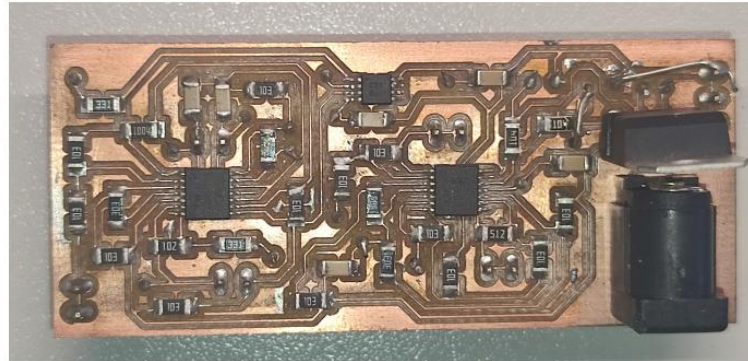
Active multidisciplinary projects



Physiology & Microbiology Related Work



Cancer antigen detection



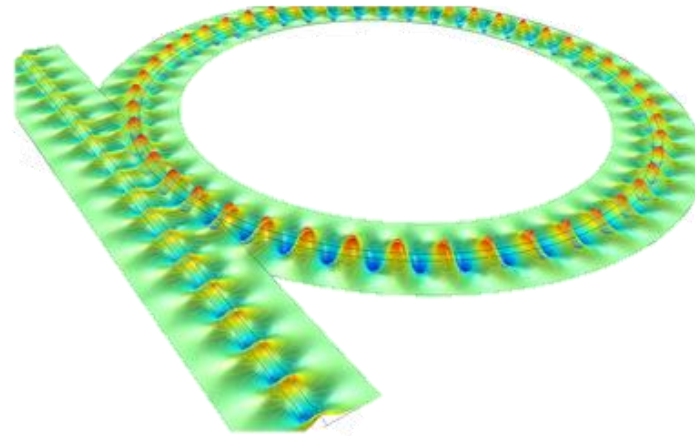
Design and prototyping:
measurement electronics



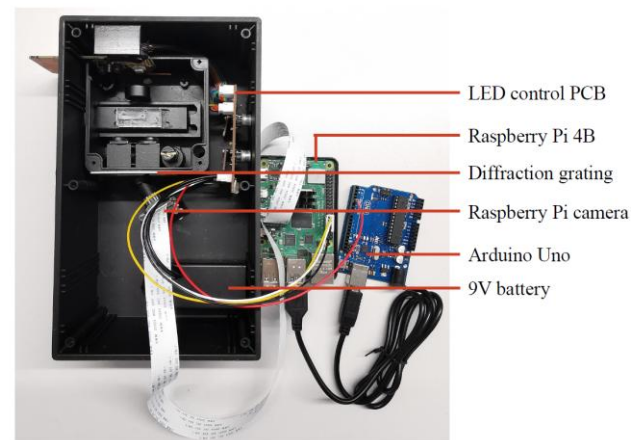
Microfluidic bioreactor
development

Physics Related Work

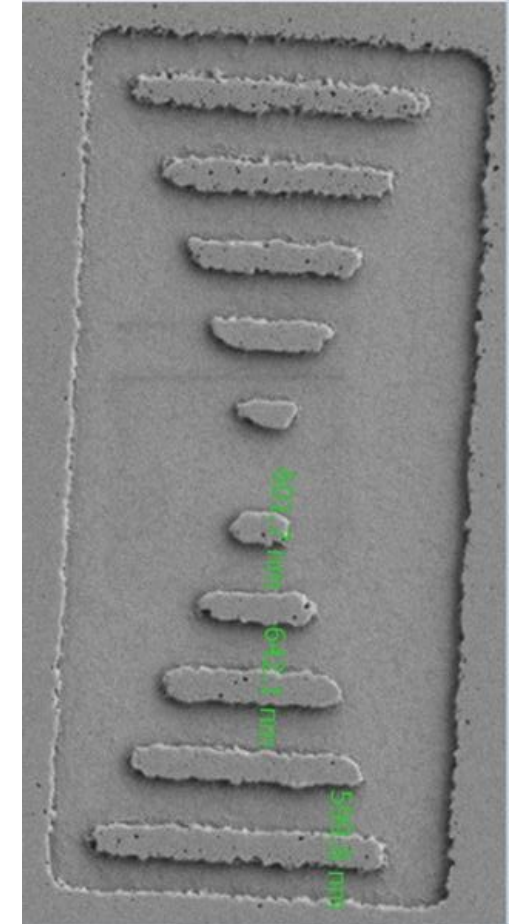
- Quantum optical measurement development,
 - Coupling problem – ultrafine diffraction gratings,
 - Biosensors with single-molecule sensitivity.
- Optical ring resonator development,
- Optical circuitry development,
 - Logic gates, true random-number generation,
- Novel spectrometer biosensor system,
- Fluorescence-based biosensors



Optical ring resonator



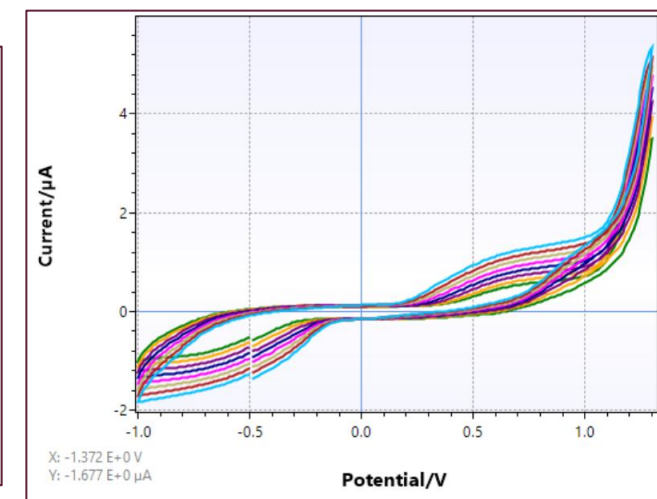
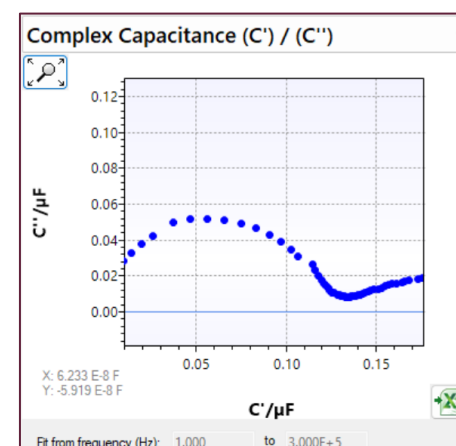
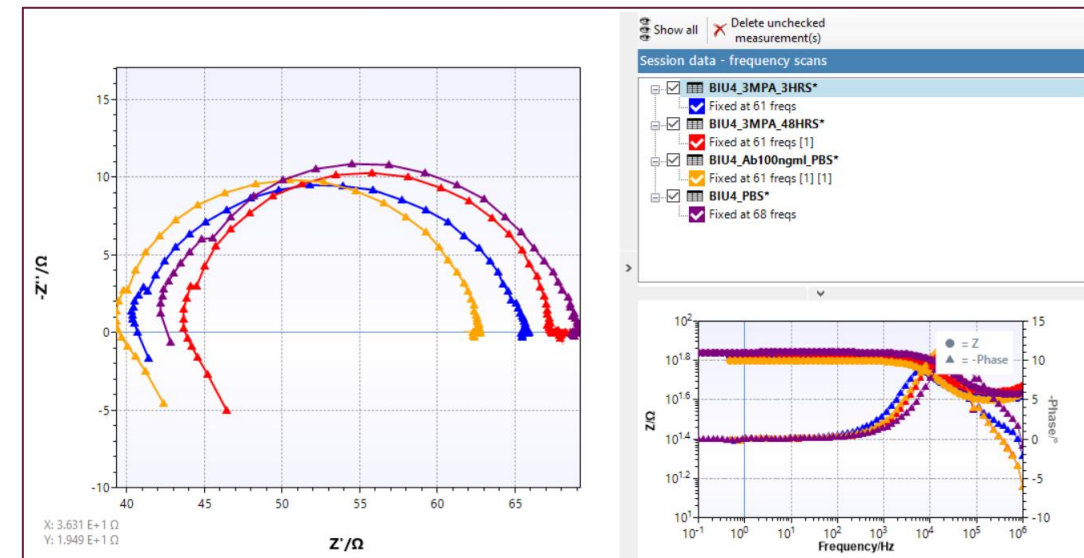
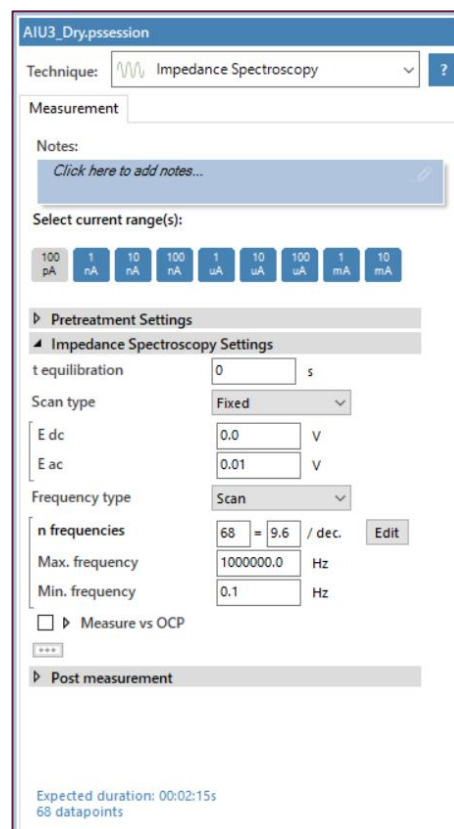
Low-cost spectrometer



Diffraction grating

Equipment & Facilities

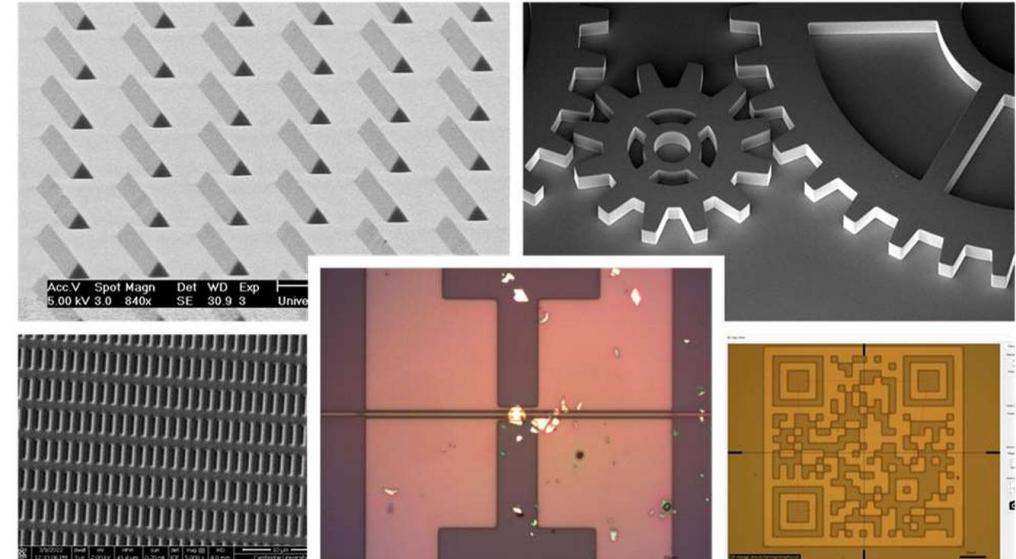
PalmSens4 Electrochemical Interface



<https://www.palmsens.com/product/palmsens4/>

Equipment & Facilities

Durham Magneto Optics ML3 Mesa (with dual wavelength light source)



- 1 μ m resolution with <0.1 μ m layer alignment accuracy,
- Ultra-high write speed,
- Automated process inspection functionality.

<https://www.durhammagnetooptics.com/?product=microwriter-ml3-mesa>

Henniker Plasma HPT-200

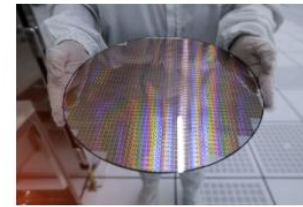
(with dual gas inlets and a special chamber to allow etching)



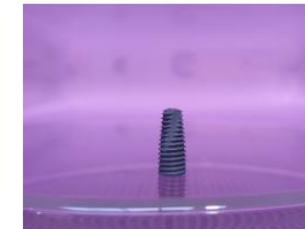
Relevant Plasma Treatments



Plasma Cleaning
of Optics & Lenses



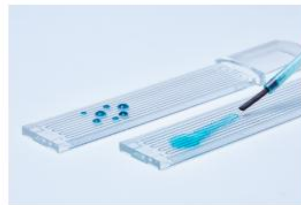
Plasma Cleaning
prior to Spin
Coating



Plasma Surface
Treatment for
Dental
Applications



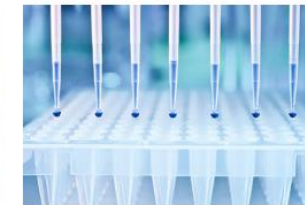
Plasma Treatment
of Medical Devices



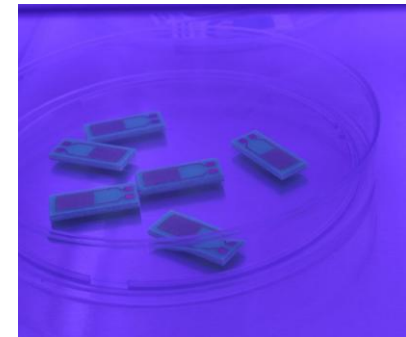
Plasma Treatment
of PDMS for
Microfluidics



Plasma Treatment
prior to Wire
Bonding



Plasmas in Life
Science
Applications



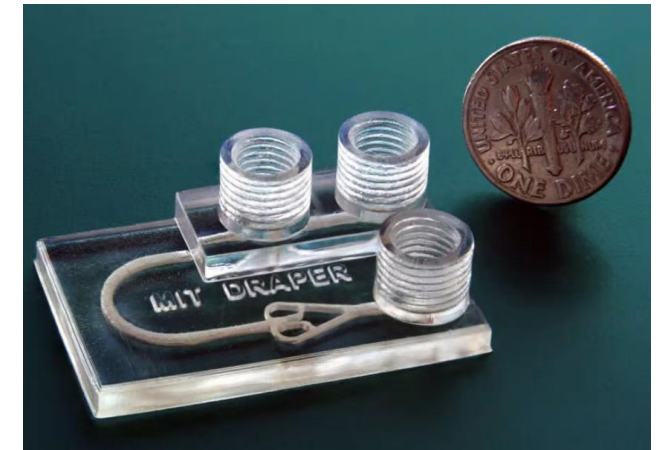
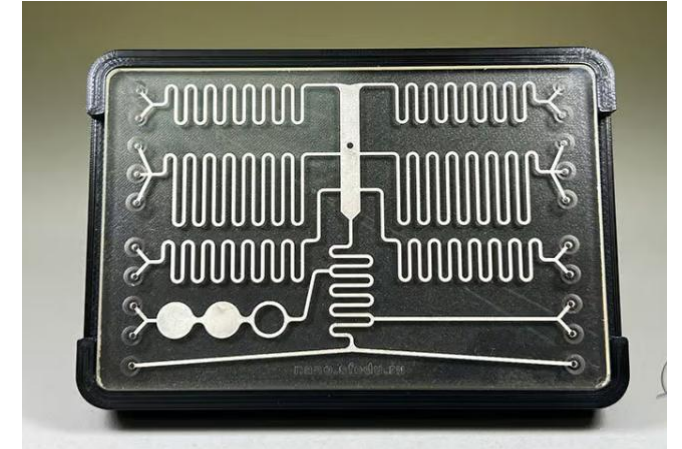
<https://plasmatreatment.co.uk/products-services/our-models/hpt-100-hpt-200>

Equipment & Facilities

Microfluidics and more:

Asiga MAX X27 Resin 3D printer

Laser cutter



<https://www.asiga.com/max-x/>

COMSOL Multiphysics

COMSOL
MULTIPHYSICS®

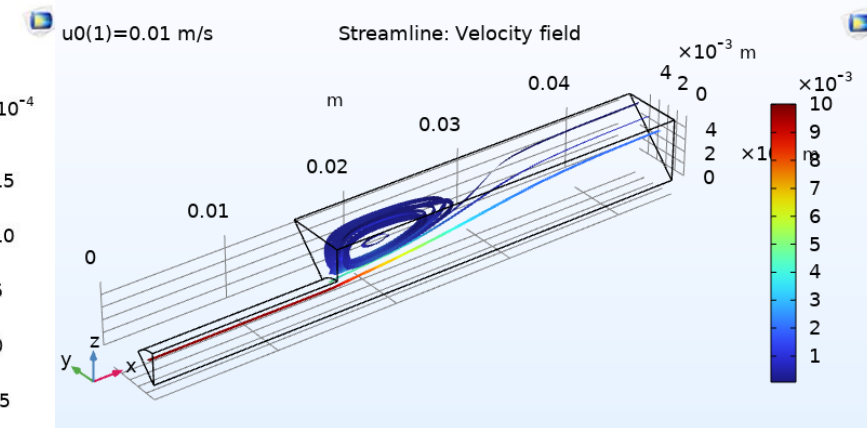
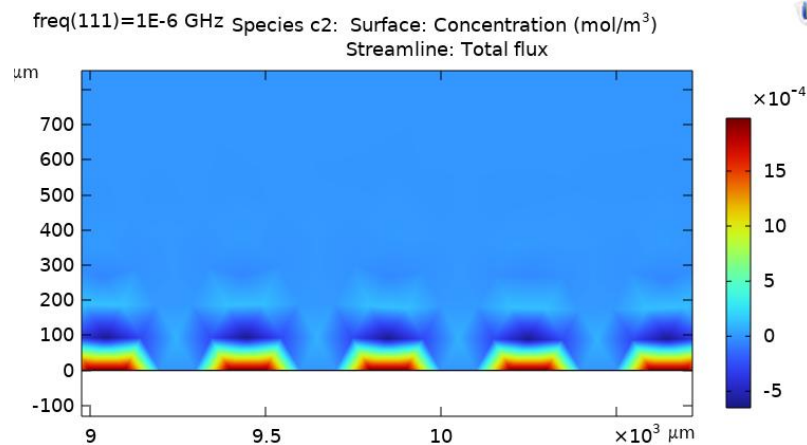


Multiphysics Software for Simulating Real-World Designs, Devices, and Processes

COMSOL Multiphysics®

It all starts with COMSOL Multiphysics®, the platform product for creating physics-based models and simulation applications. COMSOL Multiphysics® includes the Model

- COMSOL is the standard for our Multiphysics models
- Heat-transfer, wave-optics, electrochemistry, design, microfluidics and AC/DC modules for simulation of biosensors of any kind



Equipment & Facilities – COMING SOON

Angstrom Nexdep Platform (customized to perform e-beam evaporation)



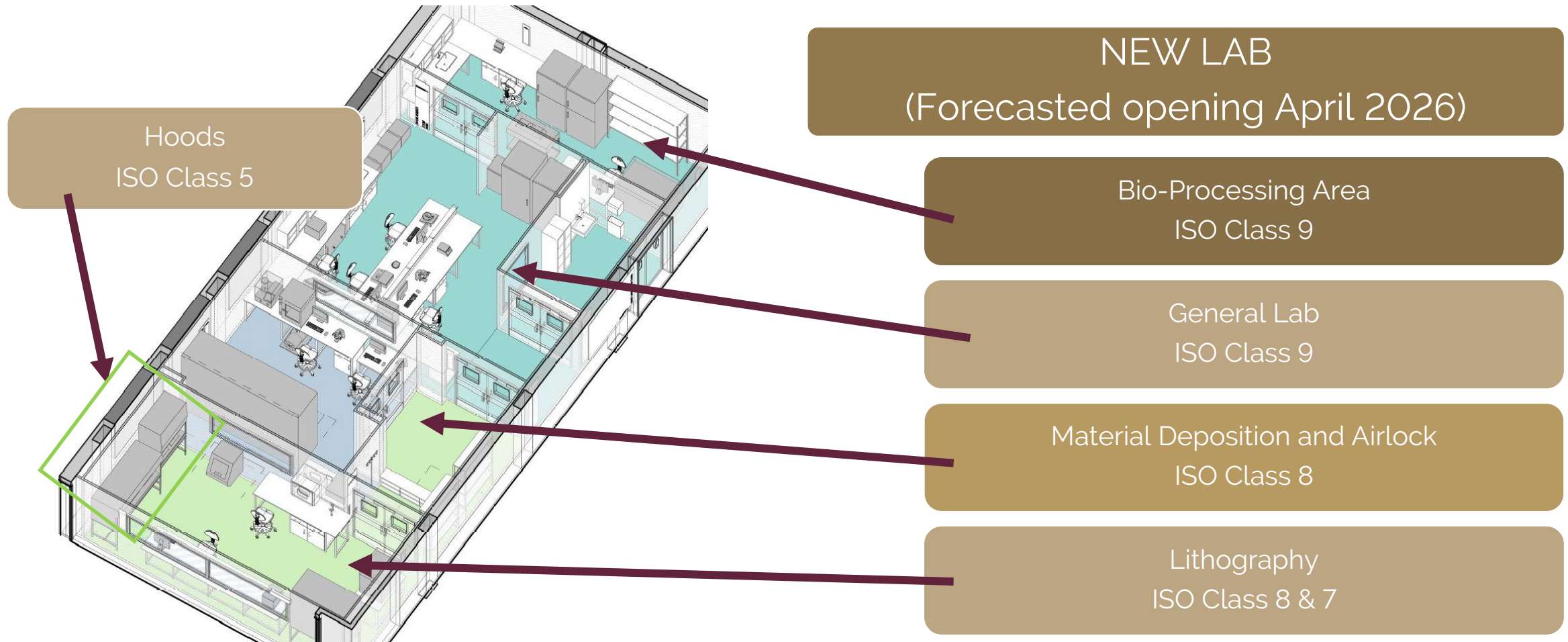
<https://angstromengineering.com/products/nexdep/>

Our specifications:

- Sequential multi-material deposition,
- Ultra-uniform coating with redundant measurement,
- High-speed cycle times - max 30m pump down,
- Cryo-cooling system with temperature control between 0 °C and 300 °C,
- Custom substrate holder to deposit up to 4x 5" wafers or 2x6" wafers simultaneously.

Equipment & Facilities – COMING SOON

ISO Certified Laboratories and Cleanroom





Stellenbosch
UNIVERSITY
IYUNIVESITHI
UNIVERSITEIT

Engineering
EyobuNjineli
Ingenieurswese

Thank you
Enkosi
Dankie