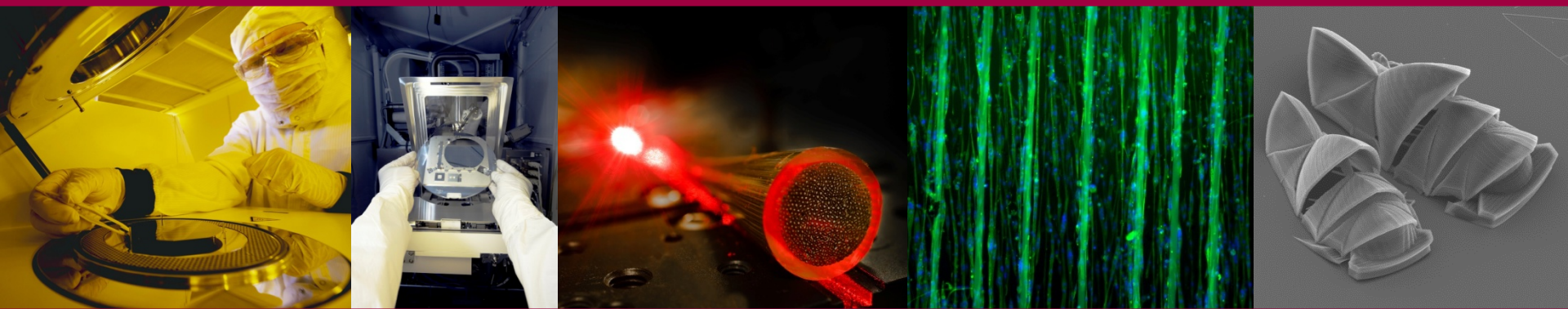


# *The Role of Research Infrastructure in Supporting Research Collaborations*



*Rosie Hicks, CEO Australian National Fabrication Facility, 17 April 2018*

# *Australian National Fabrication Facility*

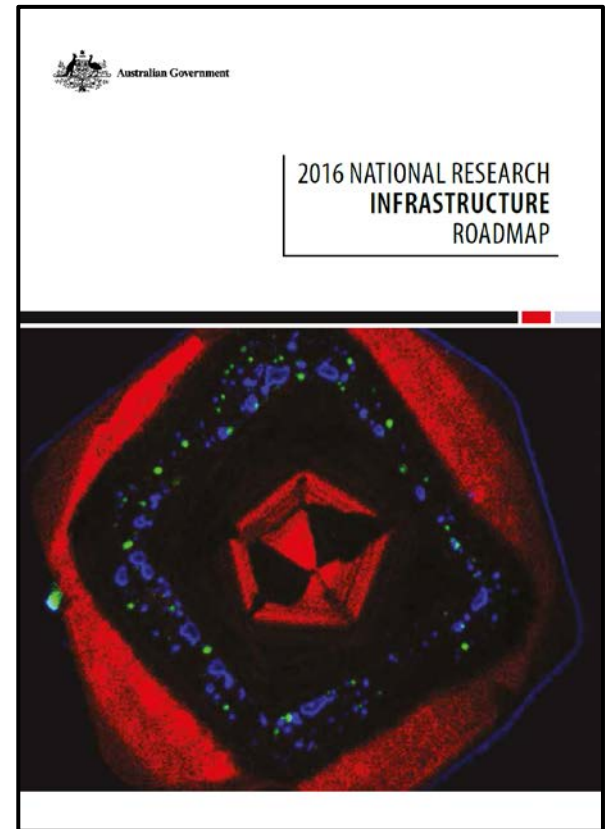


*A company established under  
NCRIS to provide nano and  
micro-fabrication facilities for  
Australia's researchers*

## **NCRIS**

National Research  
Infrastructure for Australia

An Australian Government Initiative



# The Australian Research Landscape



**Australian Government**  
**Australian Research Council**

**\$783.6m**

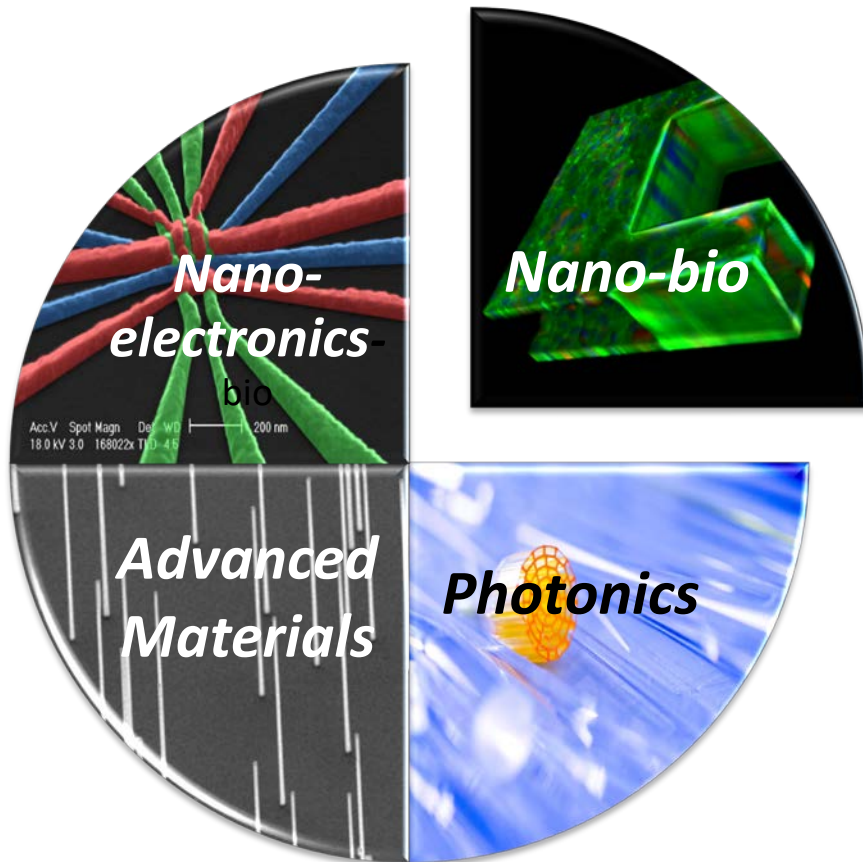


**\$832.3m**



Categories of research infrastructure funding programs

# ANFF – national research infrastructure



## What is ANFF?

- 19 universities and CSIRO in a national network of open-access laboratories
- 94.4 FTE ANFF staff
- >500 tools across Australia

## How?

- \$139 m Federal Government
- \$33 m State Governments
- \$10 m CSIRO
- \$45 m participating institutions
- Leveraging \$89 m in-kind

Total investment exceeding **\$300 m**



# *Australian National Fabrication Facility Ltd.*



- Each of the eight nodes specializes in a different area of expertise, building on areas of world-class research.
- ANFF is headquartered at the purpose-built Melbourne Centre for Nanofabrication.
- ANFF staff support researchers and industry to access the tools directly or fabricate specialty products.

*Providing nano and micro-fabrication facilities for Australia's researchers*

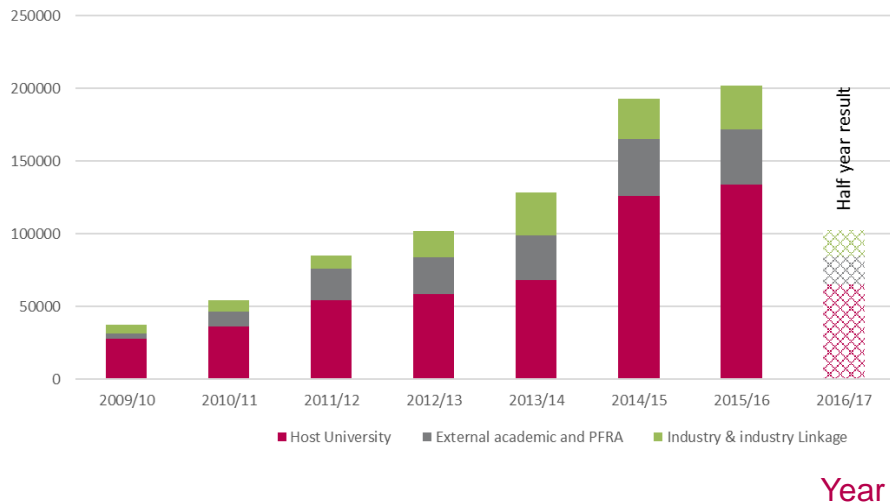
# Supporting world-class R&D...



- 2962 users
- >220,000 hours of access
- 608 peer reviewed publications in 2015

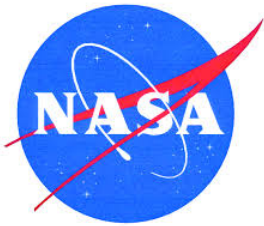


## Hours of use



- Future Low-Energy Electronics Technologies FLEET
- Exciton Science ACOEES

*...along the discovery chain*



**ANFF supports every stage across the entire discovery chain**





Supported by the Australian Government through the Department of Innovation, Industry, Science and Research



[www.anff.org.au](http://www.anff.org.au)

ANFF - AFOSR Joint Workshop



Australian National  
Fabrication Facility Ltd

## ANFF - AFOSR Joint Workshop

MELBOURNE, 18 - 19 JULY 2011



ABSTRACT BOOK



2011

2012

2015

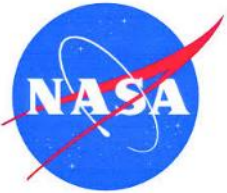
2016

2018





# Researcher exchanges



*Development of SQIF technology using high TC superconductors, CSIRO – NASA*



*Incorporation of carbon nanomaterials in 3<sup>rd</sup> generation solar cells, Flinders Uni – Virginia Tech*

# Printable power



**Goal:** Printing solar cells using a conventional printing press

**Solution:** Ink contains semiconducting organic electronic materials – conductive and photovoltaic – on clear laminated sheets, \$10/m<sup>2</sup>





# Queensland Quantum Optics Laboratory, UQ

eQus

ARC CENTRE OF EXCELLENCE FOR  
ENGINEERED QUANTUM SYSTEMS



ANFF

**2012**

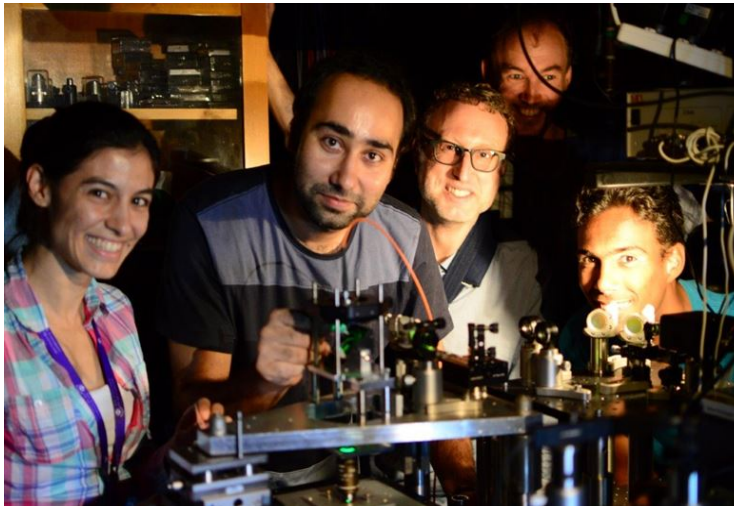
**May** ANFF/  
AFOSR  
meeting in  
Washington  
DC



**AFRL** Dr Hope Beier, on applications of quantum sensing techniques into biological imaging, including the development of new techniques to probe molecular dynamics with unprecedented precision.

**AFRL** Dr Joel Bixler on smart microscopy, including applications deep learning and artificial intelligence to improve microscope performance.

**NASA** Dr Felix Miranda at NASA Glenn Laboratories on the development of new approaches to magnetometry for applications in space communications and sensing. Supported by DARPA, ARC, Boeing, and DST Group.



**UTS** Prof. Francesca Iacopi on the development of ultralow dissipation silicon carbide resonators for applications in next generation inertial and biochemical sensors.

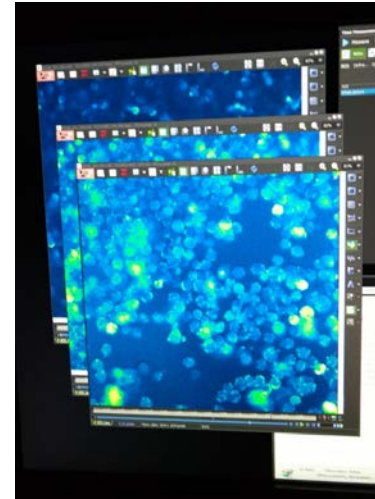


# Centre for Nanoscale BioPhotonics, CNBP



**2012**

**May** Prof Jim Piper attended the Enabling Technologies meeting in Washington DC



**2018** ANFF

**July** Dr Morgan Schmidt to visit CNBP - one of three WoW visitors

Mr Logan Jenkins from Vanderbilt University awarded 2018 American Australian Association CNBP Fellowship

**2015 & 2016**

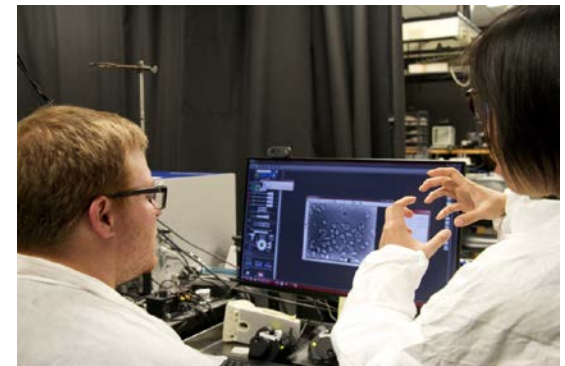
**Nov** Australian delegation participates in Biophysics and Human Performance program review, San Antonio & Dayton

Links established with Vanderbilt University








**2018**

**January** Dr Jon Jacobsen & Dr Jiajun Liu (UoA) visit Vanderbilt University



# Leverage and Legacy of AFOSR in Australia



AUD\$\$\$	Leveraged organisations	Contributions
 An Australian Government Initiative National Collaborative Research Infrastructure Strategy	NCRIS  ANFF	Infrastructure & Knowhow
Australian Government Australian Research Council	Centres of Excellence  Centre for Nanoscale BioPhotonics ARC CENTRE OF EXCELLENCE	Science, People & Knowhow
	ARC Training Centres  <b>BIOREACTOR</b> ARC Training Centre in Biodevices at Swinburne	Training & Industry

Transdisciplinary  
Externally motivated  
Translational  
Relevant  
World class  
Unique capabilities  
Unique workforce



## 2012

### May Emerging Technologies meeting in Washington DC

Prof. Thomas Nann (ANFF-SA former director) presents ANFF-SA capabilities including microfluidic process intensification

Dr Felix Miranda of NASA Glen, Prof. Carlos Cabrera & A/Prof. Craig Priest agree to collaborate on microfluidic ammonia fuel cells



## 2014

### May UniSA-UPR MOU signed

### July UPR/UniSA/NASA microgravity experiments in Houston, Texas

### October 21 A/Prof. Priest visits UPR supported by Australian Academy of Science

### October 26 [Conference paper](#) presented at MicroTAS



Future Industries Institute



ANFF

ANFF

## 2018

### Formalising relationship between UniSA & NASA Glen facilitated by ANFF-SA

Topics of research agreed with possible commencement in 2018



## 2013

### May 20 A/Prof Priest visits University of Puerto Rico (UPR)

A/Prof. Priest presents to Centre for Advanced Nano-Materials team & conducts preliminary feasibility experiments of microstructured electrodes

### December 4 Dr Eduardo Nicolau (UPR) visits UniSA for joint experiments



## 2017

### March/April UPR students visit UniSA

Myreisa Morales and Nadja Solis visit UniSA for six weeks to conduct fabrication experiments

### October 30 A/Prof. Priest visits NASA Glen

A/Prof. Priest presents in Communications & Intelligent Systems Division Distinguished Technical Lecture Series







*Enabling Technologies Technical Exchange  
Washington DC, May 2015*



*International Basic Research Infrastructure Meeting  
Italian Embassy, Washington DC, Nov 2015*

*Enabling Technologies Technical Exchange  
UNSW, Sydney, May 2016*

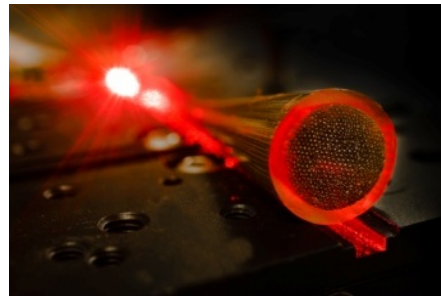
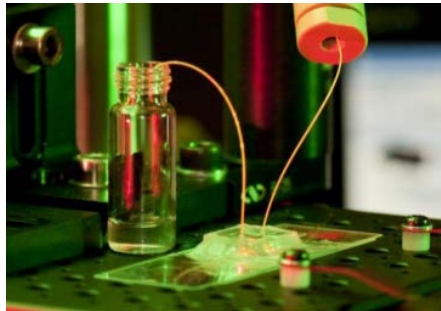
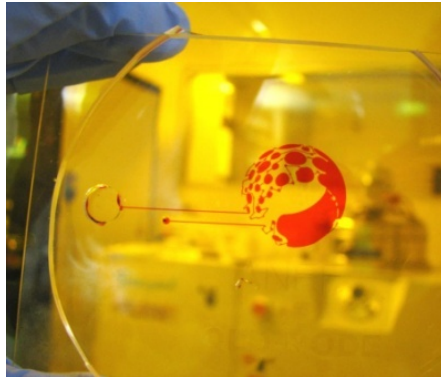
# NCRIS

National Research  
Infrastructure for Australia

An Australian Government Initiative



# Summary



- ANFF supports Australia's strengths in micro and nano fabrication with a breadth of technologies.
- Provides access to unique capabilities for process scaling.
- Provides a smooth transition from university to pilot scale production.
- Improves the value proposition for investors (higher speed, lower risk, flexible).



**NCRIS**  
National Research  
Infrastructure for Australia  
An Australian Government Initiative



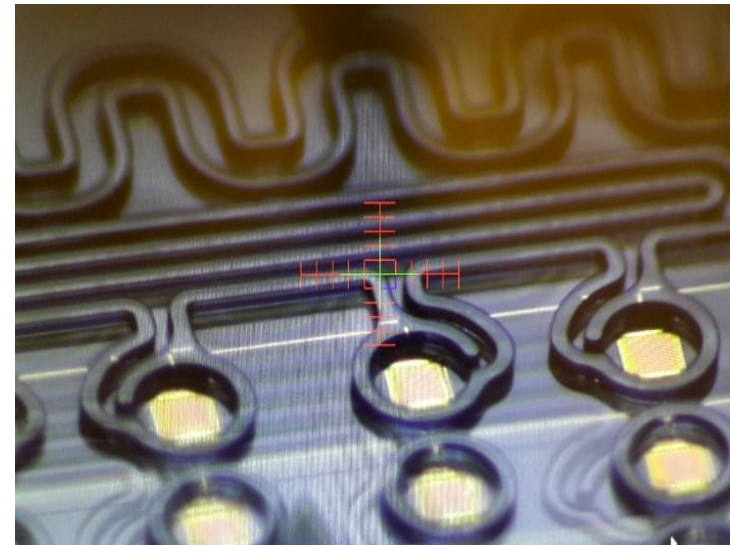
- 
- developed on a  
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- e the
- Australian Government**
- NCRIS**  
National Collaborative  
Infrastructure for Australia
- NATIONAL COLLABORATIVE RESEARCH  
INFRASTRUCTURE STRATEGY: BUILDING  
AUSTRALIA'S RESEARCH EXCELLENCE**
- Sustainable and effectively targeted  
investment in world-class national  
scale research infrastructure underpins  
Australia's capacity to innovate and  
secure our long-term prosperity.
- That is why the Australian Government committed \$150  
million to the National Collaborative Research Infrastructure  
Strategy (NCRIS) in the 2014 Budget.
- As Australia's leading-edge research infrastructure network,  
NCRIS provides the equipment and expertise to enable  
Australian researchers to compete with the world's best,  
and Australia's industries to increase their productivity  
through new products and processes.
- Since 2004, the Australian Government has invested over  
\$2.5 billion to deliver world-class research infrastructure.  
This investment has attracted more than \$1 billion in  
co-investment from universities, research agencies, state  
and territory governments and industry.
- DELIVERING REAL BENEFITS  
FOR THE NATION**
- NCRIS infrastructure makes  
research that is  
and across
- By funding major national infrastructure, NCRIS encourages  
collaborative and multidisciplinary research and provides  
Australian researchers with merit-based, ongoing access to  
high-quality research infrastructure.
- NCRIS facilitates strong partnerships between the research  
sector, business, industry and government to actively support  
world-class research. The NCRIS network currently supports  
national research capability through 27 active projects and  
facilities that employ more than 1500 highly skilled technical  
experts, researchers and facility managers in 222 institutions.  
The network supports an estimated 30,000 researchers both  
domestically and internationally.
- Importantly, the NCRIS network has strengthened long-term  
researcher-to-researcher collaboration through shared  
knowledge and access with over 30 nations around the  
world. Researchers travel to Australia to access  
edge scientific instruments, systems and facilities,  
providing our researchers with the opportunity to  
share knowledge and expertise.
- NCRIS



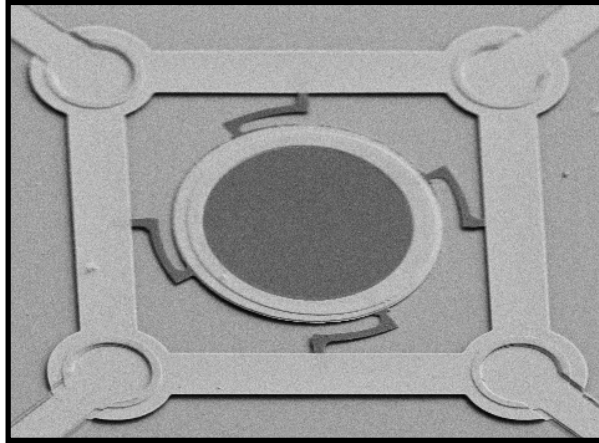
# Hand-held molecular diagnostic device

**Goal:** a low-cost portable device for non-invasive molecular diagnostics

**Solution:** ANFF-NSW technical staff have worked alongside Kimiya to fabricate a proof-of-concept lab-on-a-chip that can rapidly sequence large amounts of genetic code and transfer the information to a laptop or smartphone.



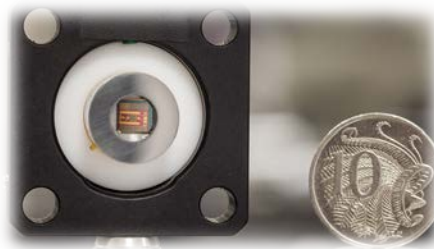
# MEMS-based microspectrometers



**Goal:** on-chip spectroscopy and imaging for field portable systems in collaboration with Panorama Synergy.

**Achieved:**

- High speed (extremely low mass)
- Low cost fabrication using standard IC processing
- Robust and field portable
- Dramatically reduced SWaP (hand-held and UAV mountable)

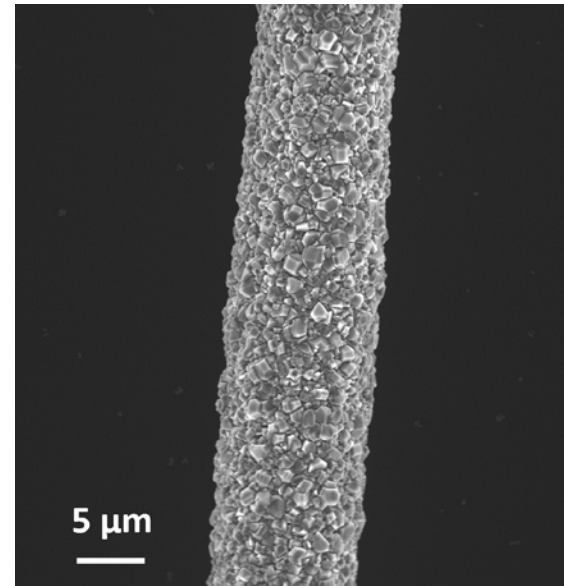




# Biocompatible micro-electrodes

**Goal:** flexible, lightweight biocompatible micro-electrodes for electrical stimulation of neural pathways.

**Solution:** combine the exceptional properties of the diamond and carbon fibre, with carbon fibre as the conducting core and diamond as the insulating biocompatible coating.

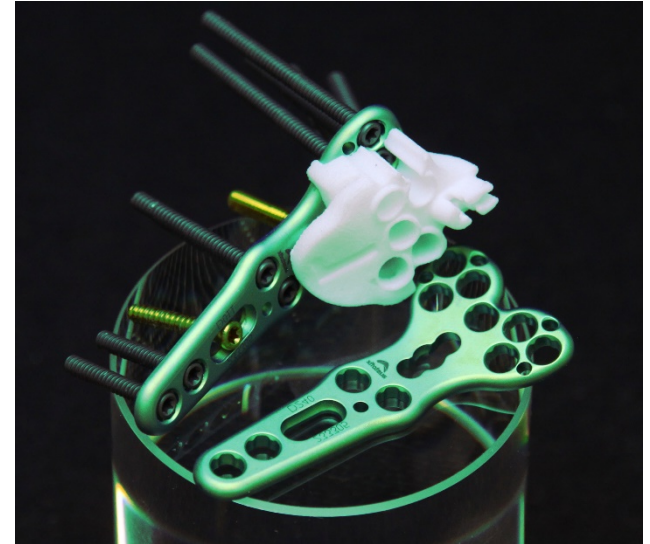




# Improving wrist fracture recovery

**Project:** Take a new wrist fracture plate system from conception to production-ready in just nine months.

**Made use of:** Optofab's advanced manufacturing capabilities, including precision 3D metal printing and advanced ultrasonic milling.



**“[ANFF] was key to our ability to take the prototype to market within such a short timeframe.”**

**Chris Henry,  
Austofix GM**

# Bio-printing technology



**Goal:** direct-write printing of stem cells within biomaterials presents an opportunity to engineer neural tissue for in vitro modelling.

**Goal:** BioPen for treatment of osteoarthritis (OA)

**Result:** A handheld 3D printing pen for “drawing” human stem cells in freeform patterns with extremely high survival rates.



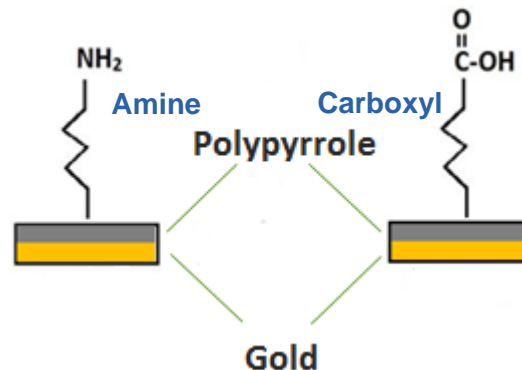
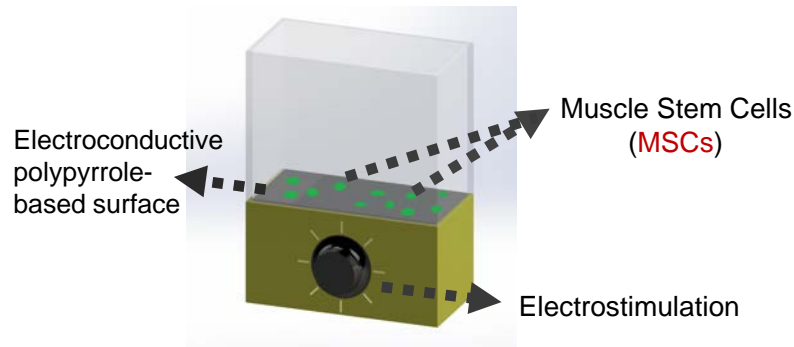




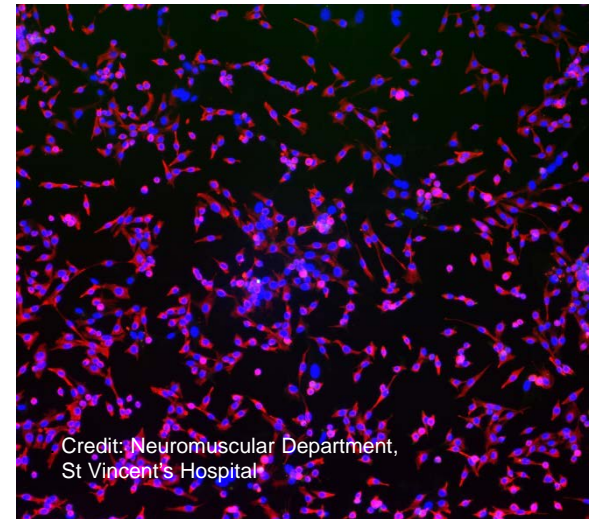
# A platform for stem cells

**Problem:** Muscle cells become less proliferative following prolonged culture.

**Solution:** Mimic electric signals from nerves in vitro to maintain cells in a proliferative state.



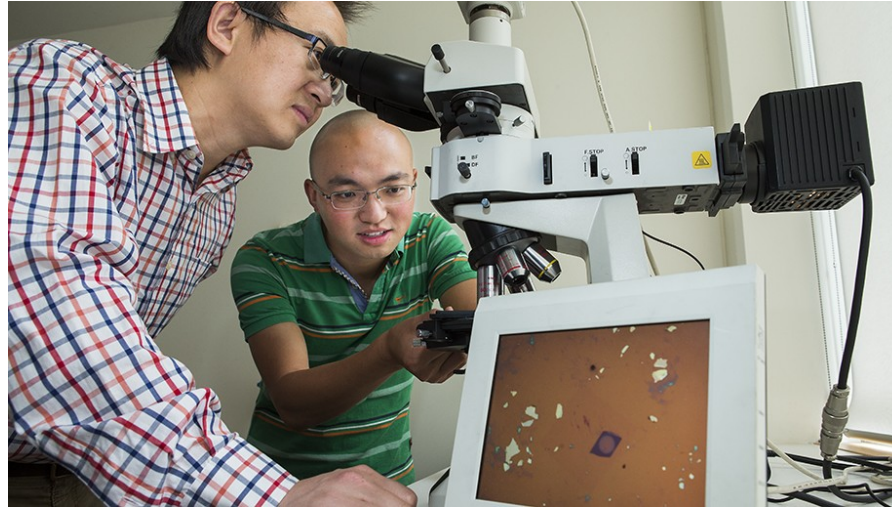
Plasma polymerised amine and carboxyl groups on polypyrrole to enhance cell attachment.



Credit: Neuromuscular Department,  
St Vincent's Hospital

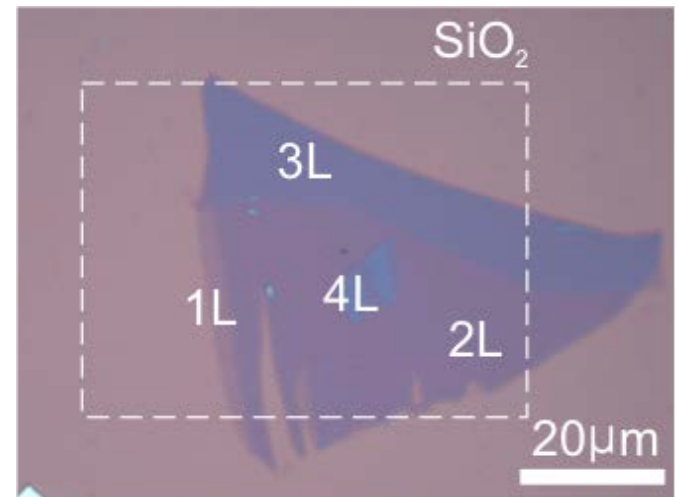
Project By: Uma Suparamaniam

# Atomically thin lenses



**Goal:** To create  
thinnest optical lens  
the world has ever  
seen

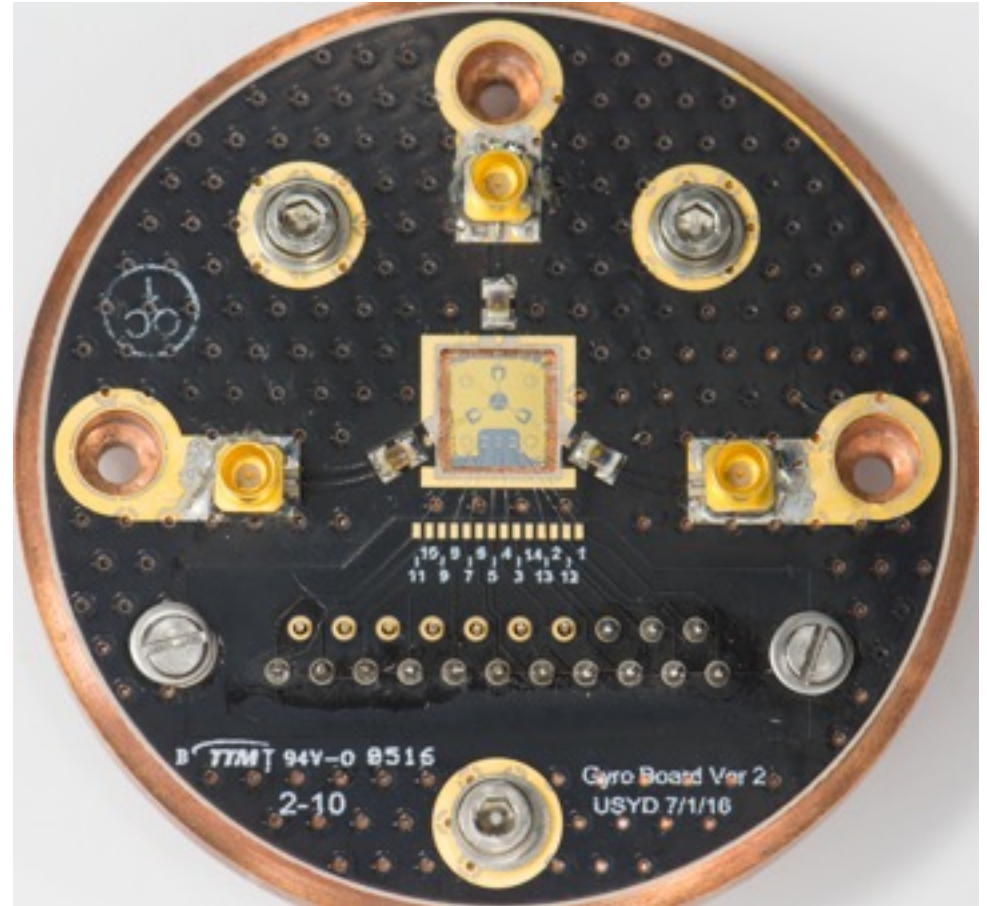
**Result:** A 6.3nm thick optical  
lens made of  $\text{MoS}_2$ .



# Scaling up quantum computing

**Goal:** To tackle the issue of size when creating a working quantum computer.

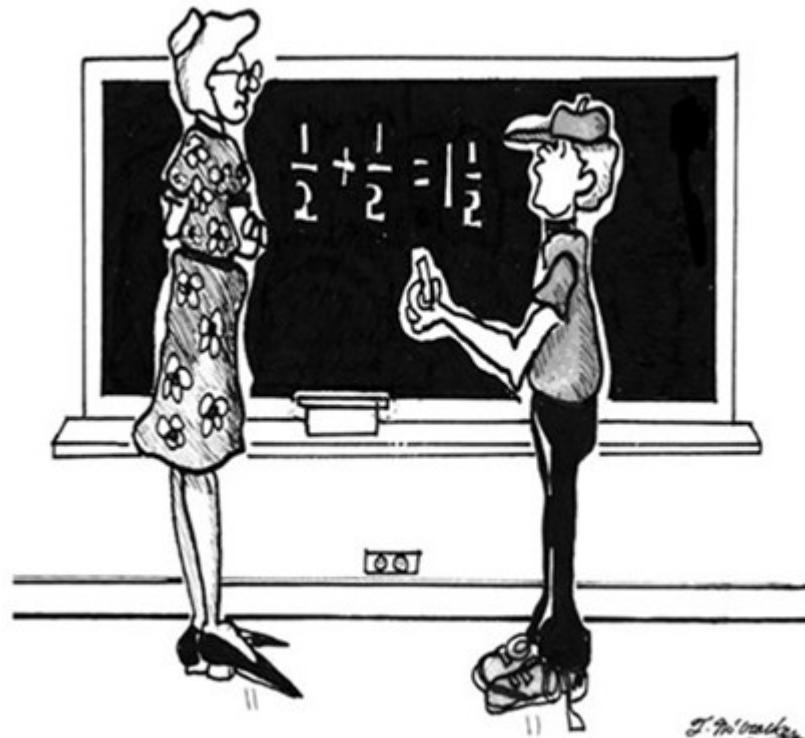
**Result:** Reducing the size of an essential component called a circulator to the micrometer scale.







ANFF



"BUT DIDN'T YOU ONCE TELL US THAT, 'THE WHOLE  
IS GREATER THAN THE SUM OF ITS PARTS?'"