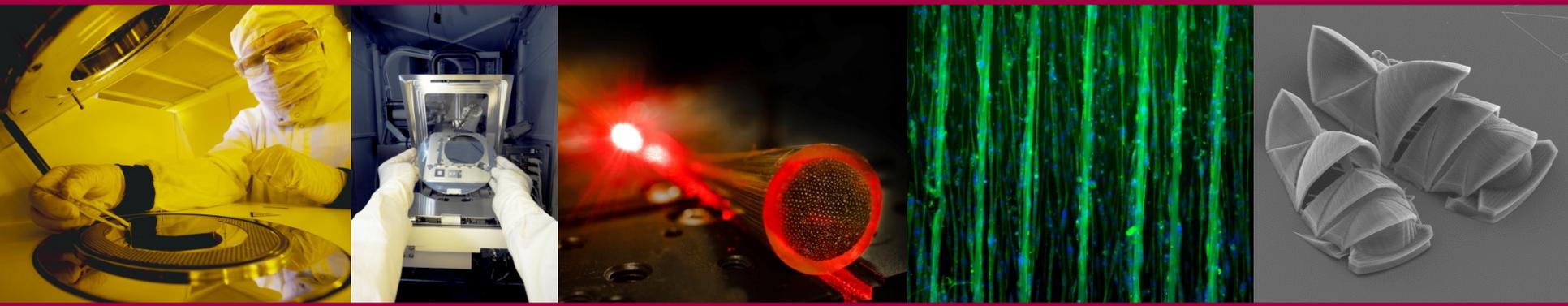


# *The Role of Research Infrastructure in Supporting Research Collaborations*



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

# *Australian National Fabrication Facility*

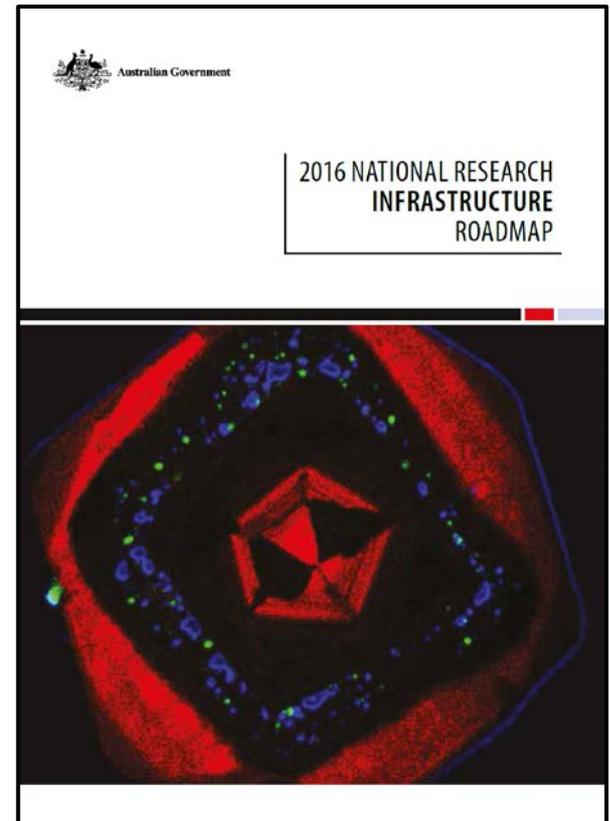


*A company established under  
NCRIS to provide nano and  
micro-fabrication facilities for  
Australia's researchers*

## **NCRIS**

National Research  
Infrastructure for Australia

An Australian Government Initiative



# The Australian Research Landscape



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

\$783.6m

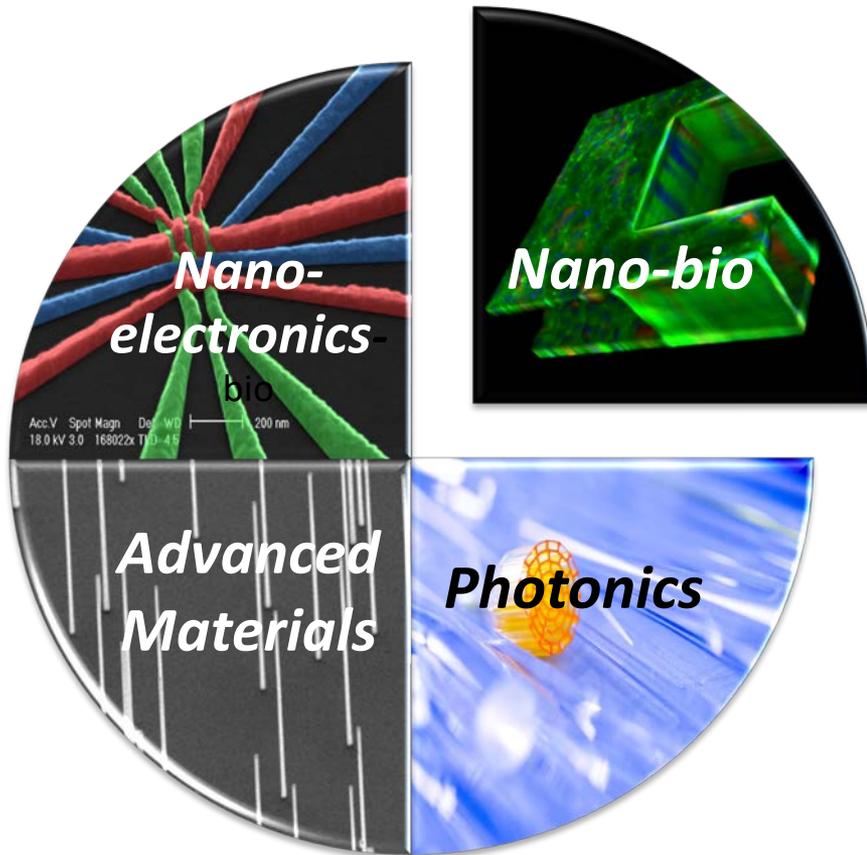


\$832.3m



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...



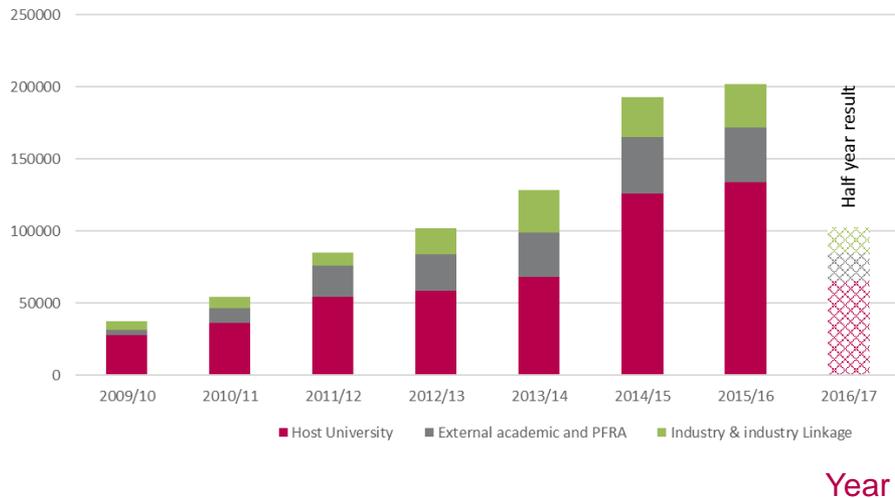
- 2962 users
- >220,000 hours of access
- 608 peer reviewed publications in 2015



ARC CENTRE OF EXCELLENCE FOR  
ENGINEERED QUANTUM SYSTEMS

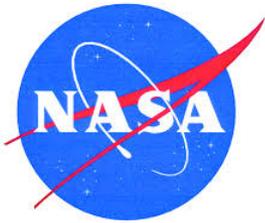


## Hours of use



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

*...along the discovery chain*



Fundamental research and proof-of-concept

Material, component or device design

Prototyping

Characterisation

Pilot scale manufacture

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



Australian National Fabrication Facility Ltd

# ANFF - AFOSR Joint Workshop

MELBOURNE, 18 - 19 JULY 2011

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

ABSTRACT BOOK



ANFF



2011

2012

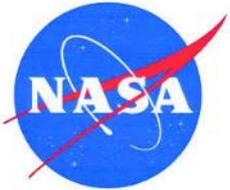
2015

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

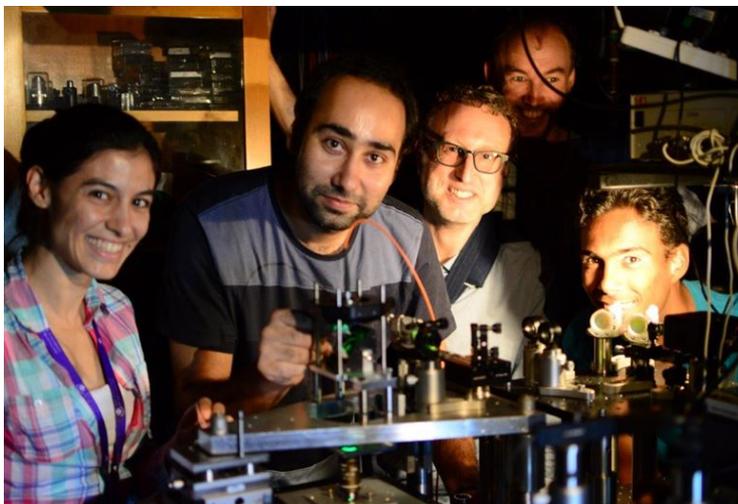
May ANFF/  
AFOSR  
meeting in  
Washington  
DC



**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.



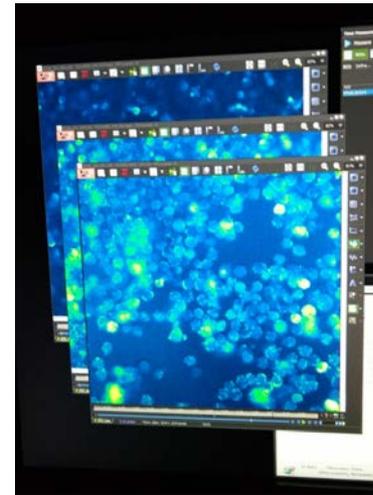
**UTS** Prof. Francesca Iacopi on the development of ultralow dissipation silicon carbide resonators for applications in next generation inertial and biochemical sensors.

# 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**

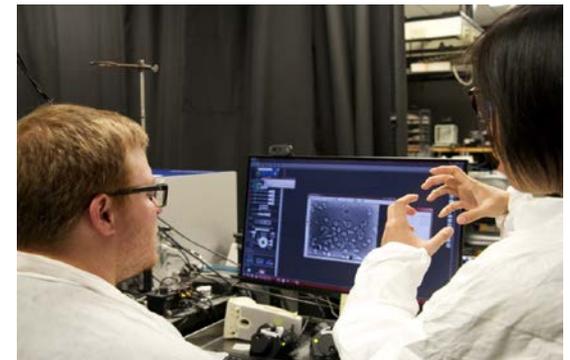
**Nov** Australian delegation participates in Biophysics and Human Performance program review, San Antonio & Dayton

Links established with Vanderbilt University



**2018**

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





## 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*

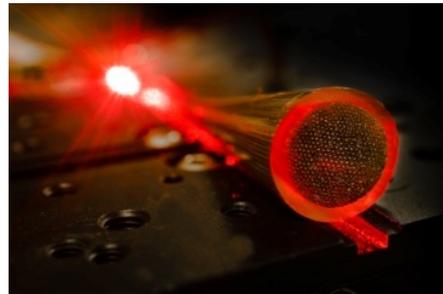
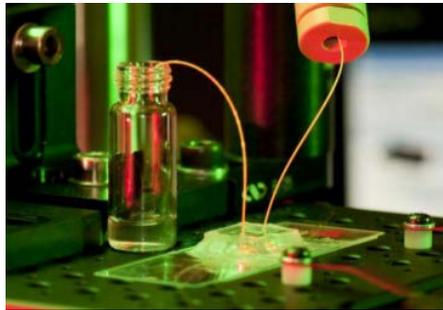
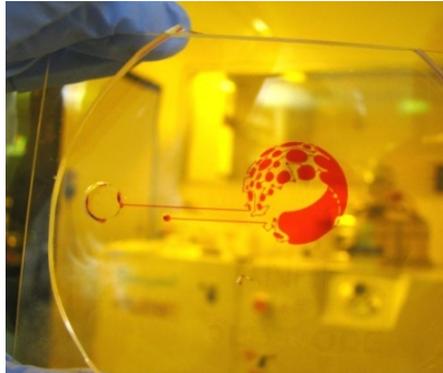
*Enabling Technologies Technical Exchange  
UNSW, Sydney, May 2016*

# NCRIS

National Research  
Infrastructure for Australia

An Australian Government Initiative





- 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 Principles



- ...investment in research infrastructure should be planned to maximise contributions to economic development, social wellbeing and environmental sustainability.
- ...resources should be **focussed** in areas where Australia is, or has the potential to be, **world-class** and provide international leadership
- Major infrastructure should be developed on a **collaborative**, national, non-exclusive basis.
- There should be **as few barriers as possible** to accessing major infrastructure for those undertaking meritorious research
- The Strategy should seek to enable the fuller participation of Australian researchers **internationally**.

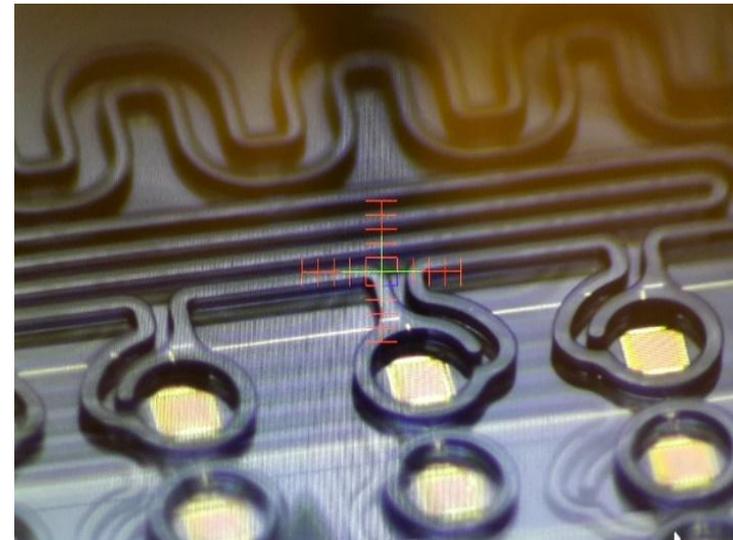




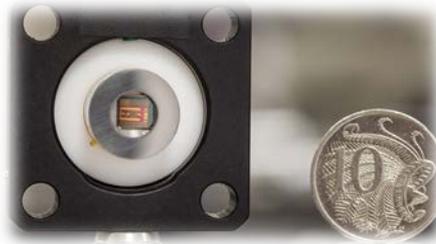
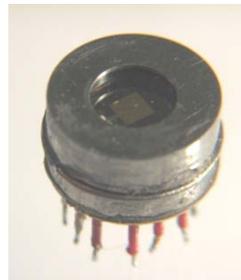
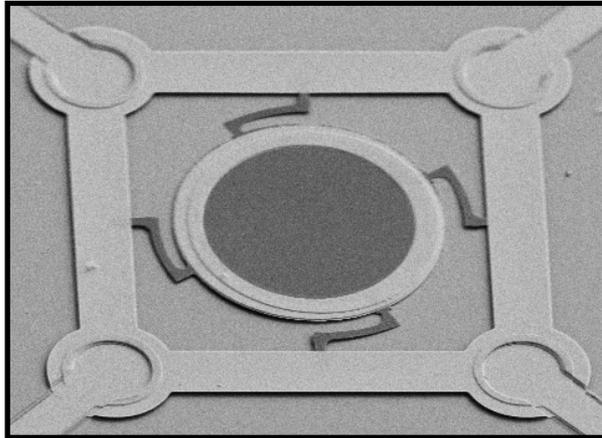
# Hand-held molecular diagnostic device

**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)

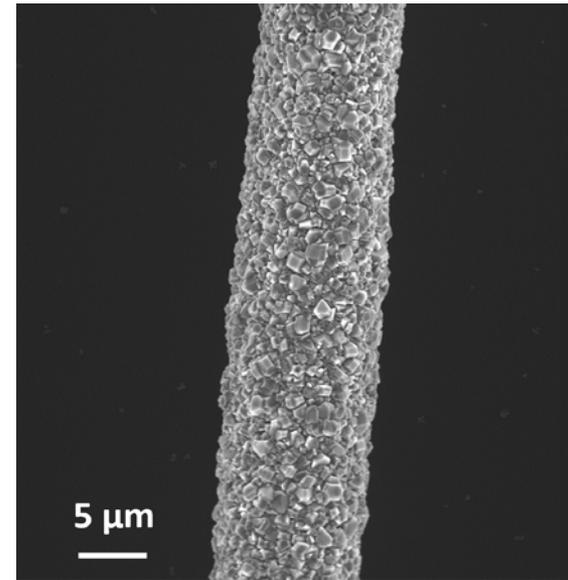




# Biocompatible micro-electrodes

**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.

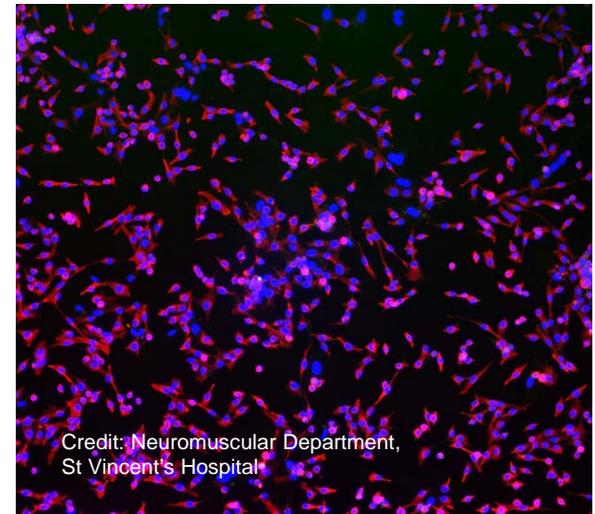
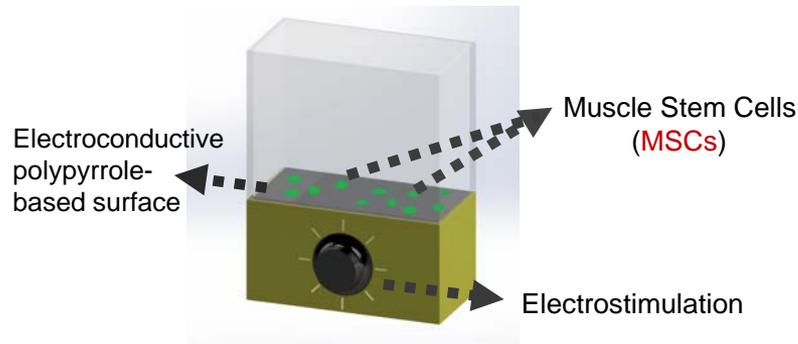




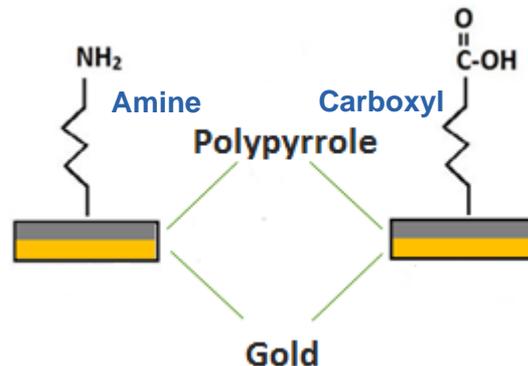
# A platform for stem cells

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

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



Credit: Neuromuscular Department, St Vincent's Hospital

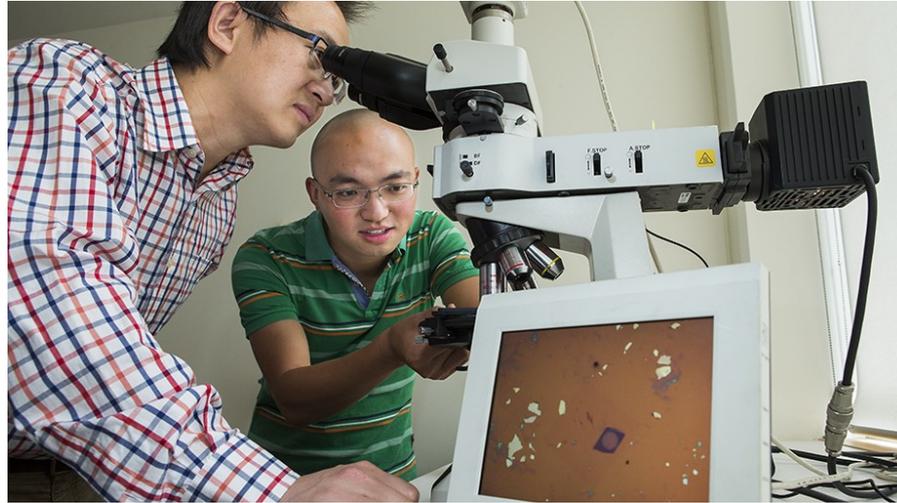


Plasma polymerised amine and carboxyl groups on polypyrrole to enhance cell attachment.

Project By: Uma Suparamaniam

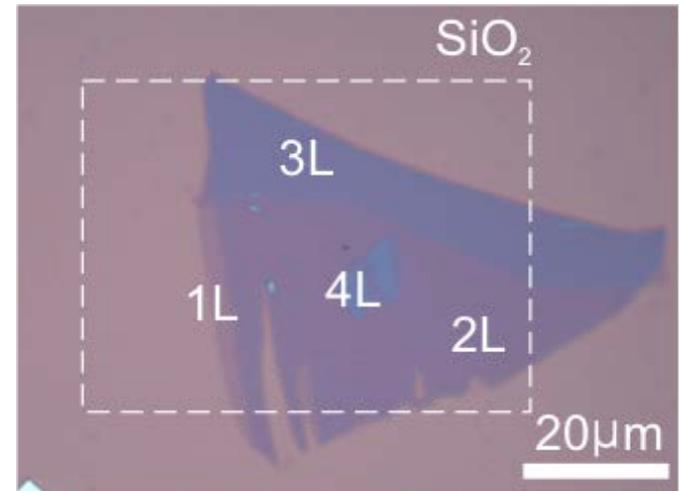


# Atomically thin lenses



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

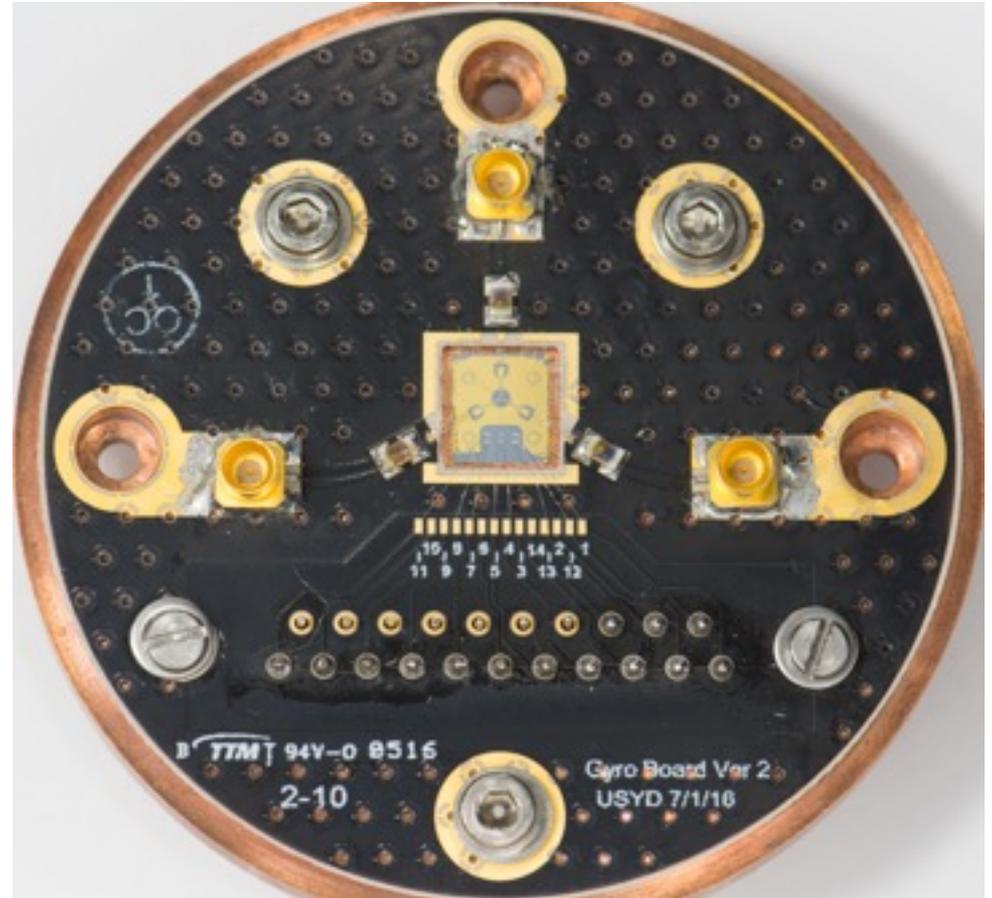
**Result:** A 6.3nm thick optical lens made of MoS<sub>2</sub>.



# Scaling up quantum computing

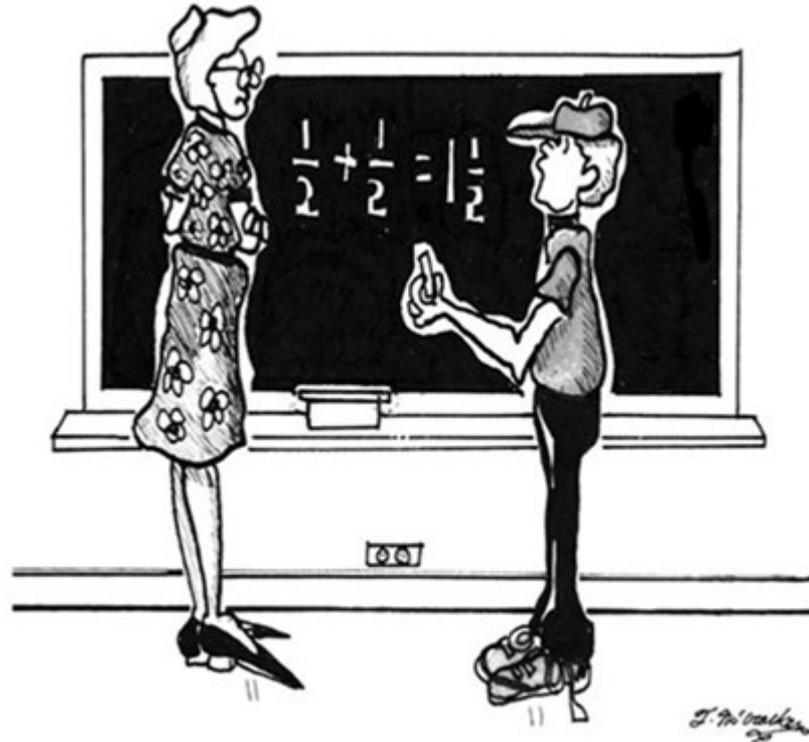
**Goal:** To tackle the issue of size when creating a working quantum computer.

**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?'"