UK Study Visit

01-27 July, 2024

Vaishnavi Thakur
D2 student
IGNITE Workshop Experience

Timeline

Cambridge Judge Business School

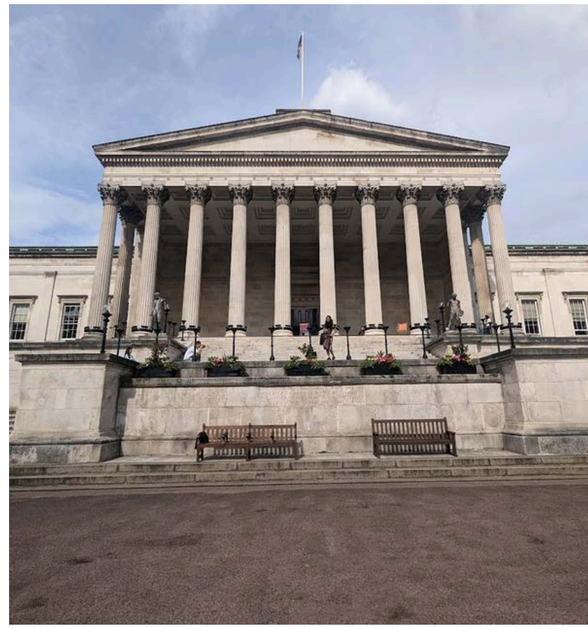
Week 1

University of Sheffield

Week 2

Cambridge University

Week 3



University College London

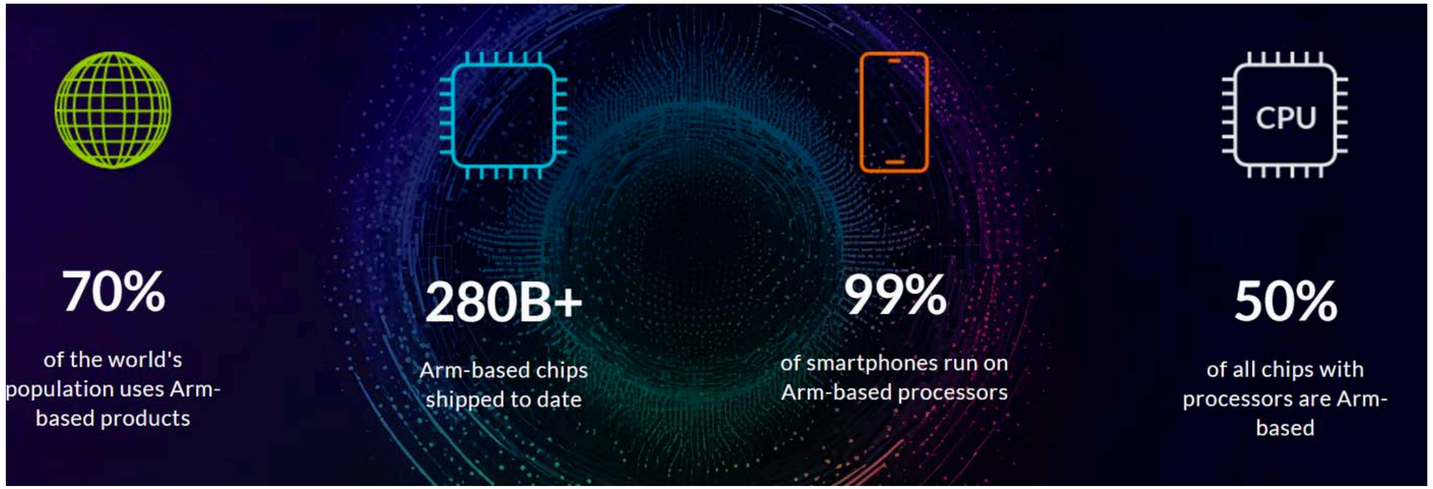
Week 4

Cambridge Judge Business School

- IGNITE 2024 program
- One week intensive course on Entrepreneurship
- Place of stay
- Cohort of around 40 members
- Guest speakers -
  - Jamie Urquhart, Partner, Pond Venture Partners (Co-Founder of ARM)
  - Dr Hermann Hauser, Co-founder of Amadeus Capital Partners (European Innovation council)

Learnings

Jamie Urquhart, Partner, Pond Venture Partners (Co-Founder of ARM)



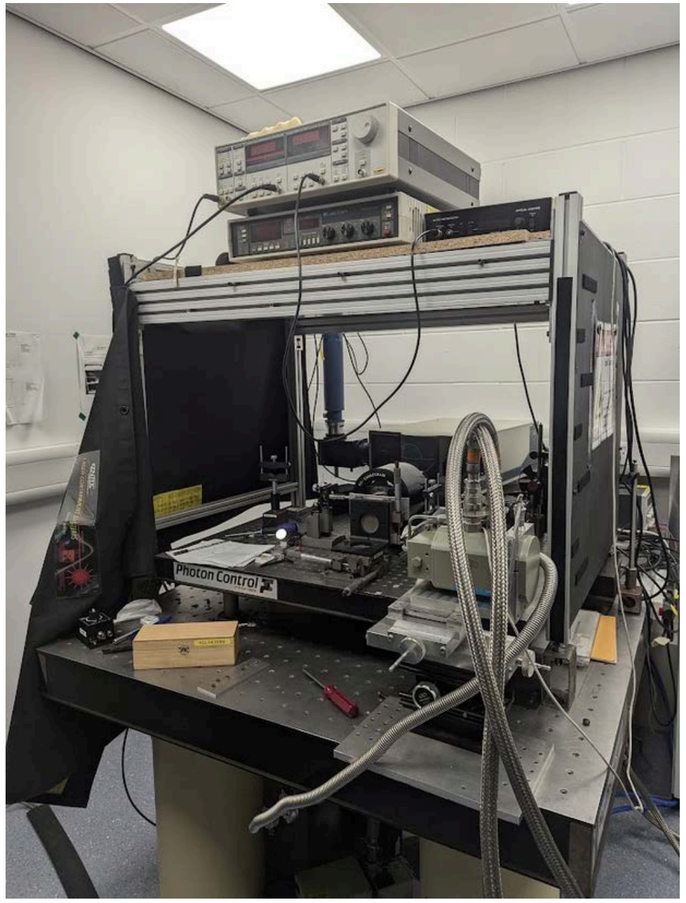
- Arm's '90 Mission Statement
  - Design competitive, low power consumption, high-performance, low-cost processors which become the accepted standard in the market they address.
  - In support of this mission ARM Ltd will develop peripheral cell designs, software and software tools and provide a design service to third parties
  - The vision was encapsulated in the statement :
    - "to become the accepted standard in the market they address"
  - Which later became
  - "The Architecture for the Digital World"
  - "Sparking the World's Potential"
- At Arm success "measured"
  - Total number of chips shipped by partners using ARM CPU - 50k in 1990, May 2022 – total of >225 billion

University of Sheffield

Dr Robert Richards

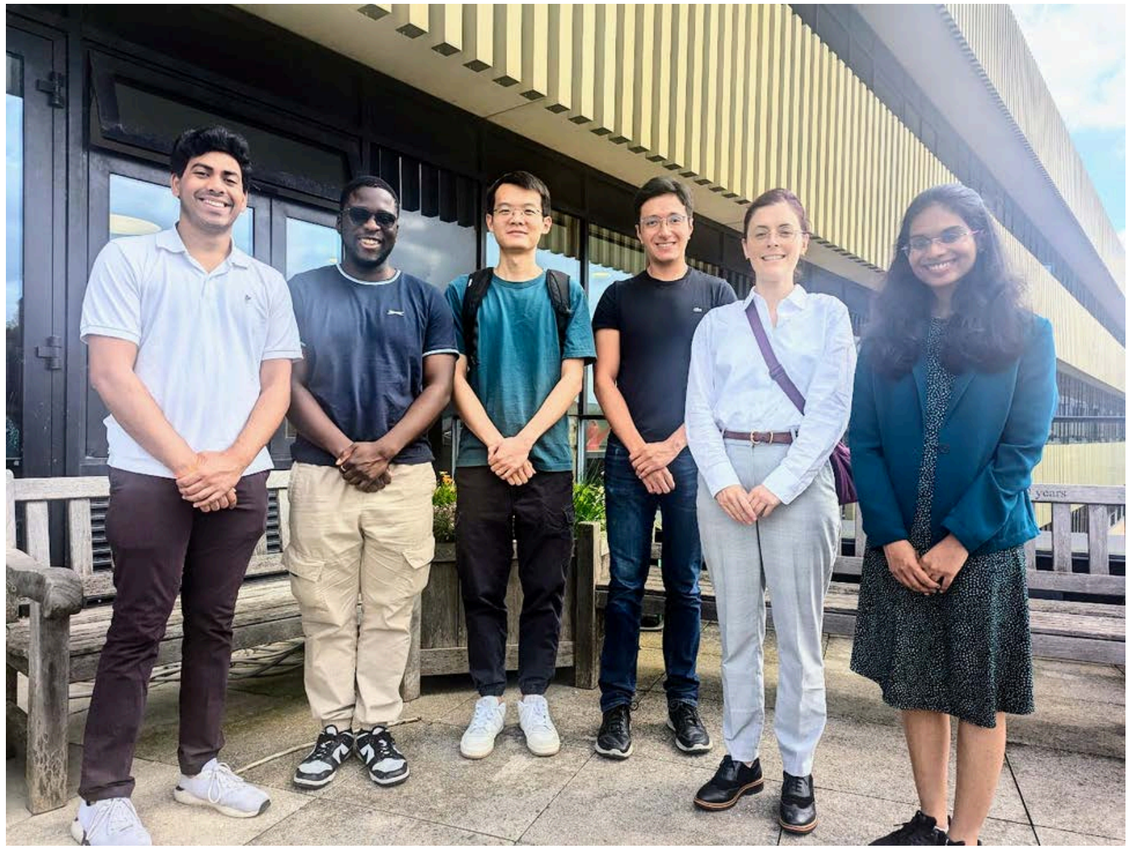
- Sheffield Bismide Semiconductors Research Group
- Current work - Dilute bismide semiconductor growth and characterisation
- Growth of highly mismatched alloys
- GaAsBi, InAsBi, and InGaAsBi

Bismide Semiconductors Research Group Equipment



- Equipment:
  - 2 molecular beam epitaxy reactors
  - temperature dependent photoluminescence,
  - dark current,
  - photocurrent and electroluminescence
- Presentation
- Future collaboration

Cambridge University



Prof. Louise Hirst and lab members

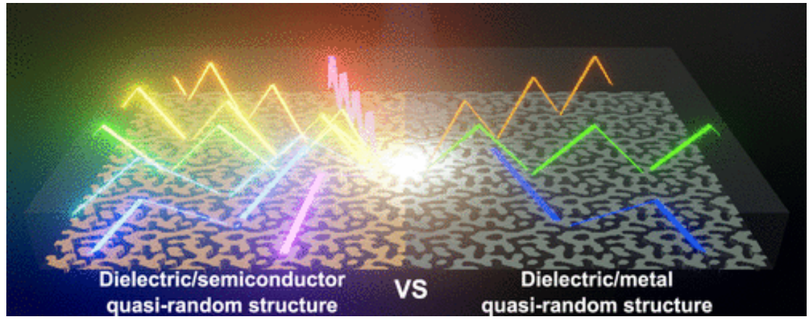
- Space PV lab, The Cavendish Laboratory, Department of Physics
- Current work
  - Ultra-thin photonic integrated devices
  - Novel III-V growth on graphene
  - Radiation damage in space environments

Space PV Lab - Research

one-to-one sessions

Light management in ultra thin solar cells

Dr. Eduardo Camarillo Abad
Postdoctoral Research Associate



- Transparent semiconductor/dielectric scattering quasi structures to the device architecture
- Broad scattering profiles

Camarillo Abad, Eduardo et al, Transparent Quasi-Random Structures for Multimodal Light Trapping in Ultrathin Solar Cells with Broad Engineering Tolerance, American Chemical Society

Ultra-thin nanowire solar cells

Anish Chaluvadi
NanoDTC PhD Student, c2021

- Simulations and experimentation on fabrication of nanowire solar cells

PL measurement of devices

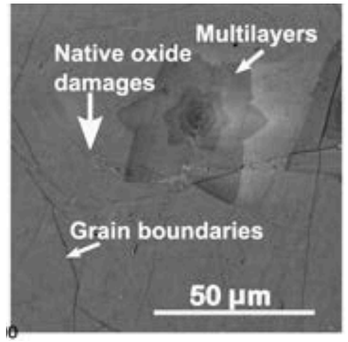
Toluwalase Agoro
PhD student

- Equipment description

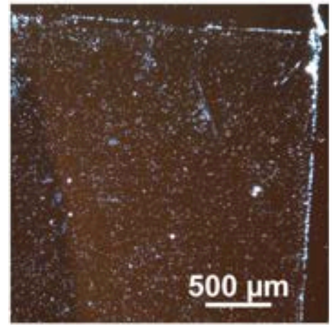
Defect seeded remote epitaxy of GaAs films on graphene

Prof. Louise Hirst

- Chemical vapour deposition growth of graphene and wet transfer to a III–V substrate with a polymer handle
- The presence of water promotes the formation of a III–V oxide layer



SEM image of graphene



Surface contaminations in dark field image

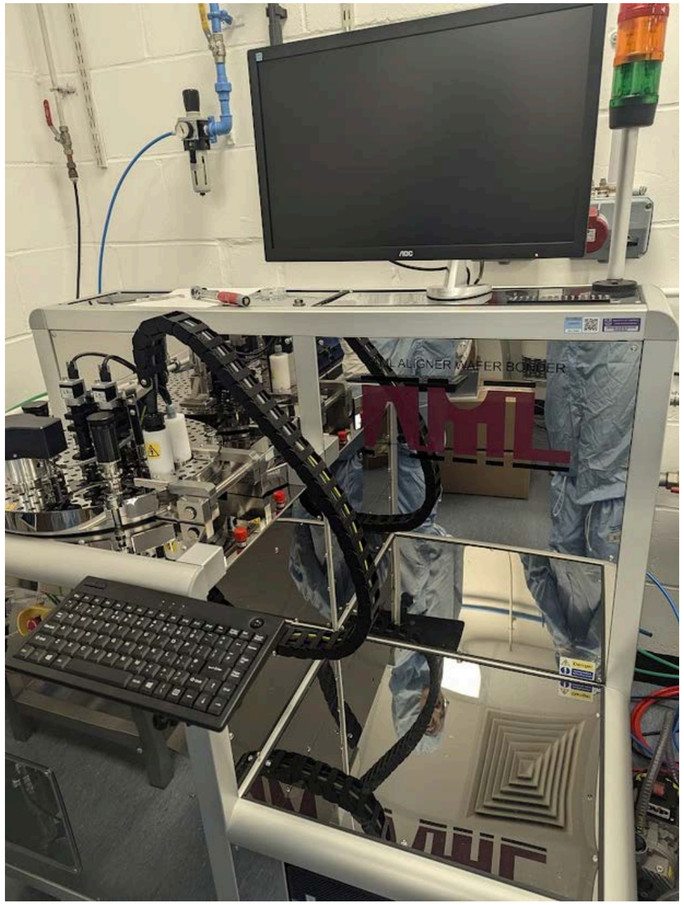
Muhammad Zulqurnain et al 2022 Nanotechnology 33 485603

The Cavendish Laboratory Equipment
Cathodoluminiscence Equipment

- Time-resolved cathodoluminescence (TRCL) scanning electron microscope (SEM)
- Fast hyper-spectral imaging of luminescence

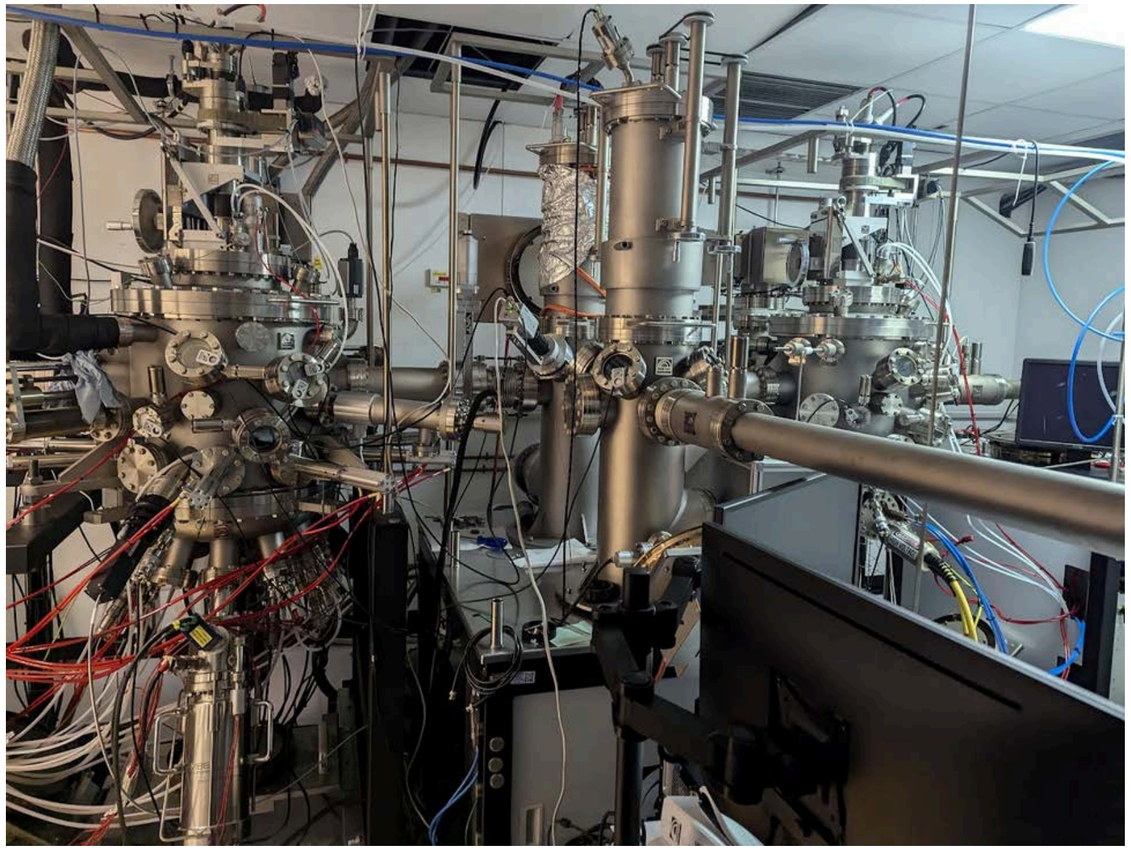
The Cavendish Laboratory Equipment

Clean room

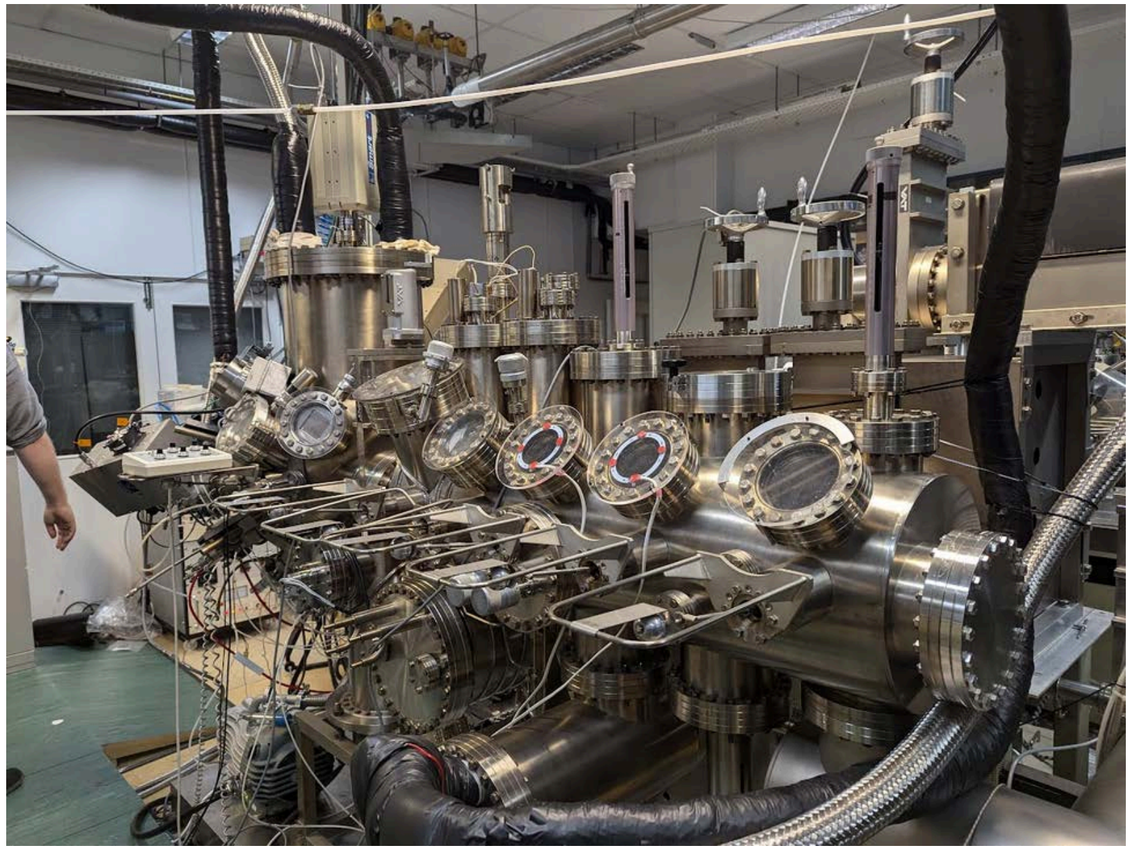


The Cavendish Laboratory Equipment

MBE Equipment

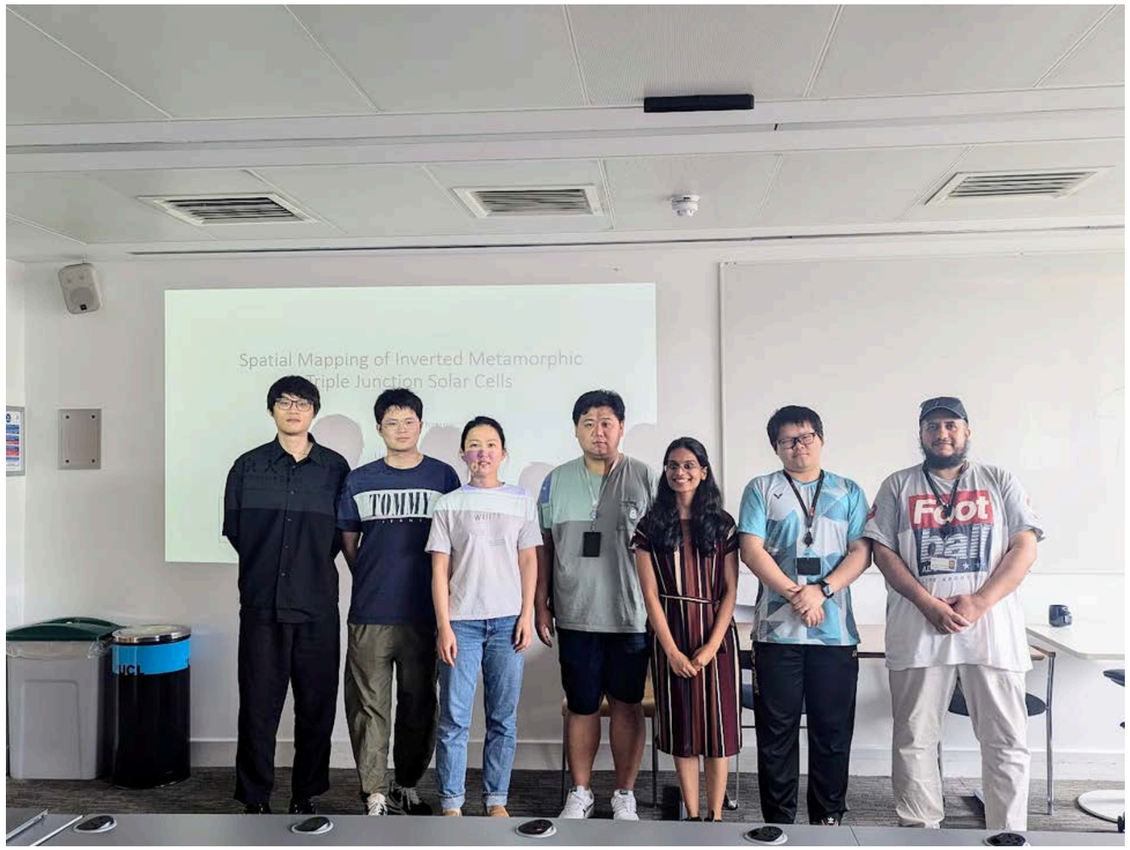


- 1986 - 4000 wafers
- Fabrication of 3D semiconductor structures
- Regrowth on patterned surfaces
- Growth of GaAs/AlGaAs system --> GaN growth (2010 onwards)



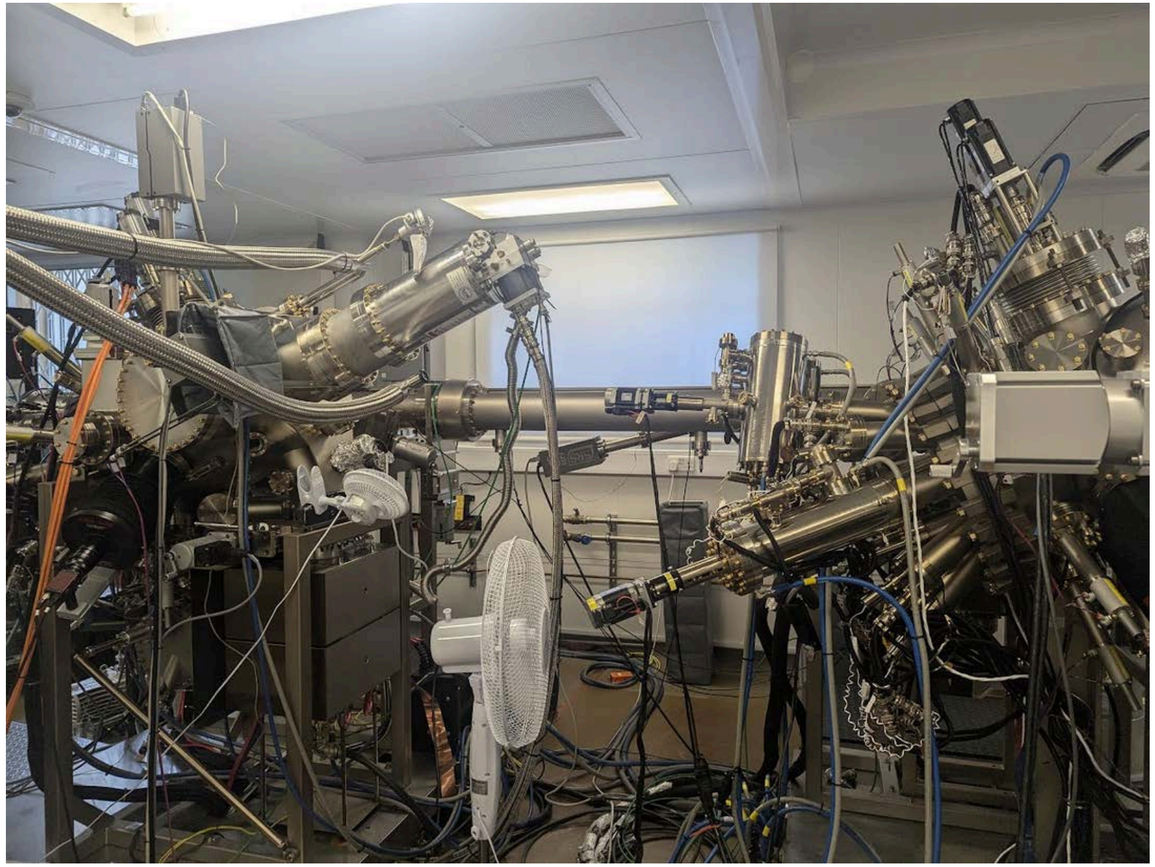
- Latest installation - 2010
- 12 source chambers
- Growth of InGaAs/AlGaAs/GaAs

University College London



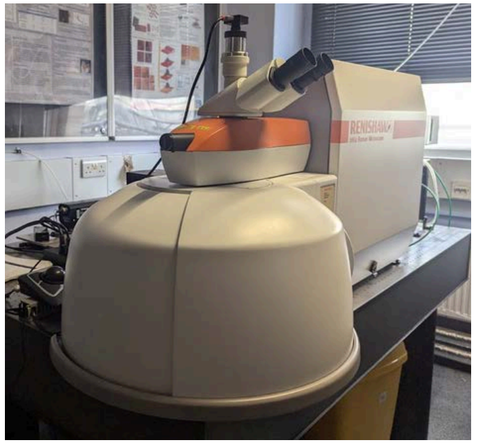
- Prof Huiyun Liu
- Current work
  - Quantum dots, quantum wires, and quantum wells using molecular beam epitaxy
  - In general semiconductor devices

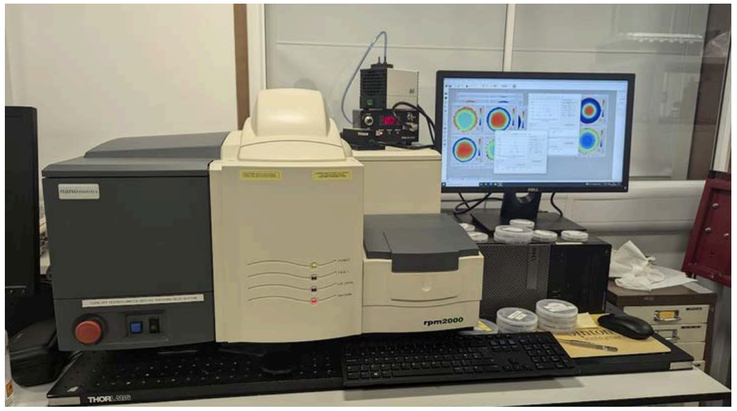
Lab Equipment



MBE equipment

- Twin chamber system - Group III-V and Group IV
- Wafers can be grown in the group IV chamber and then transferred into the III-V chamber for further III-V growth



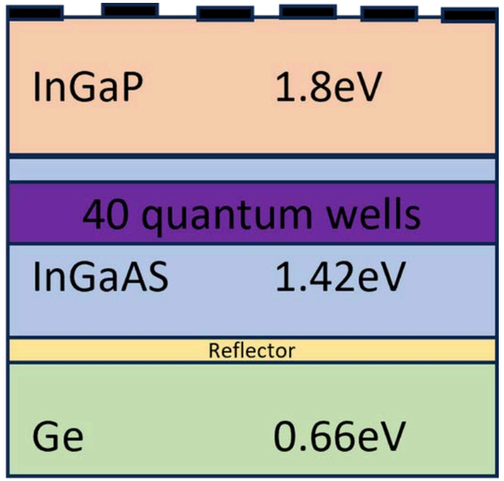


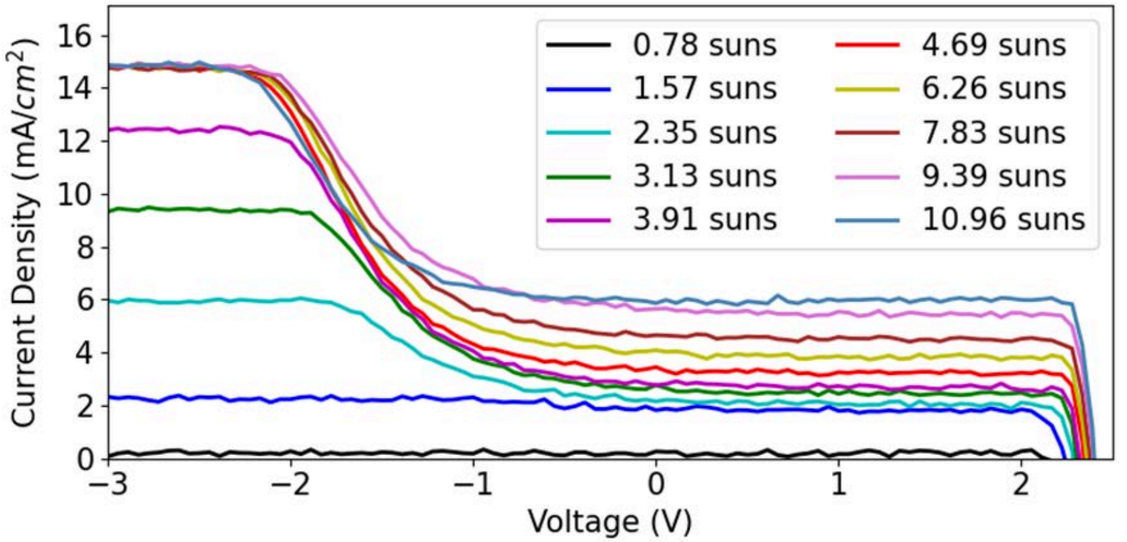
Photoluminescence mapper

- Three lasers (532 nm, 635 nm, and 980 nm)
- Two detectors (CCD and extended InGaAs detectors)
- Measurements : 600-2100 nm , 100um resolution
- Small samples and whole wafers (up to 6 inches)

Learnings

- Different labs, research work and appreciation for Okada lab
- Inputs on my work
  - Series resistance of the bottom cell of the sample
  - Measure IV curve at higher suns





- Simulation tools -
  - TMM: FDTD - Numerical software/Comsol
  - 1J SC: RCWA, COMSOL
  - Thickness/doping - Drift diffusion model - SOLCOL (Python), TCAD: Synopsis

Next Steps

- Finalise QW sample numbers
- Inputs on my work (TBD)
  - Series resistance of the bottom cell of the sample
  - Measure IV curve at higher suns
- Antimonide growth ---> Currently learning MBE growth
- Target to finish the antimonide 1J in October

Extra Curricular Activities

Suggestions for students

- Application:
  - University screening
  - Cambridge _Judge Business School screening
- Acceptance:
  - Contact professors early to schedule experiments
  - Try to visit other universities
- During program
  - Networking
  - Do not neglect the final presentation
- I have sponsored myself for 3 weeks after 1 week of Cambridge workshop
  - Expenses - 2 lakh yen

Suggestions for Department

- Start the application process one year early
- Train students - Set Sensei course
- Divide the budget so that many students can take part

Acknowledgement

Grateful to Sumiyo San and Set Sensei for their support from Step 0