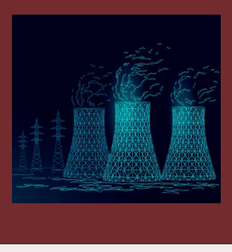
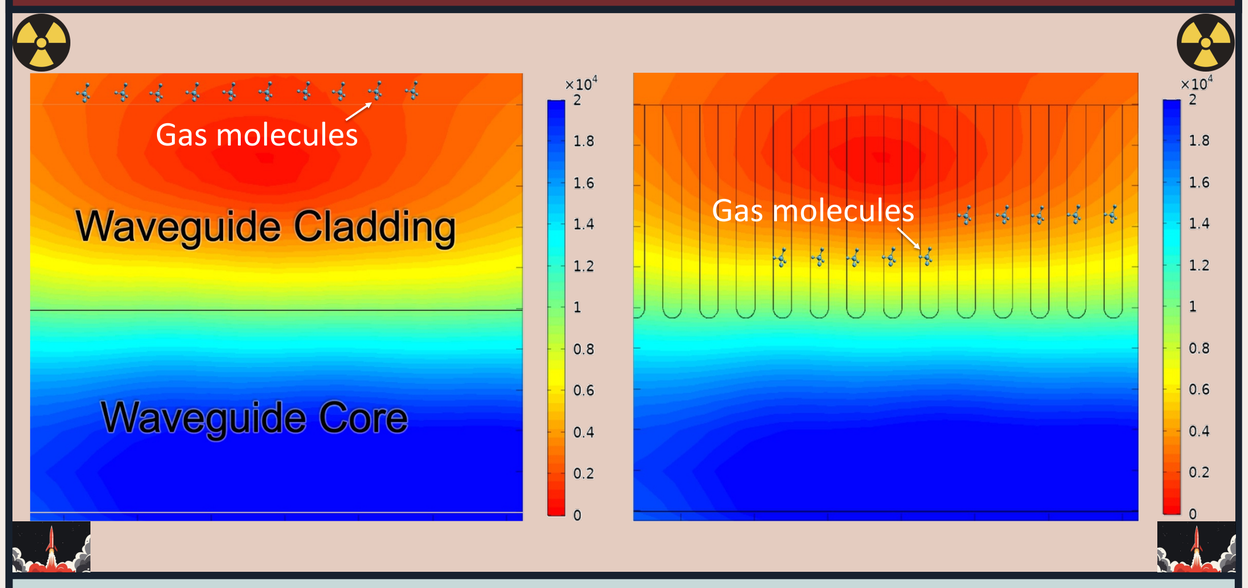


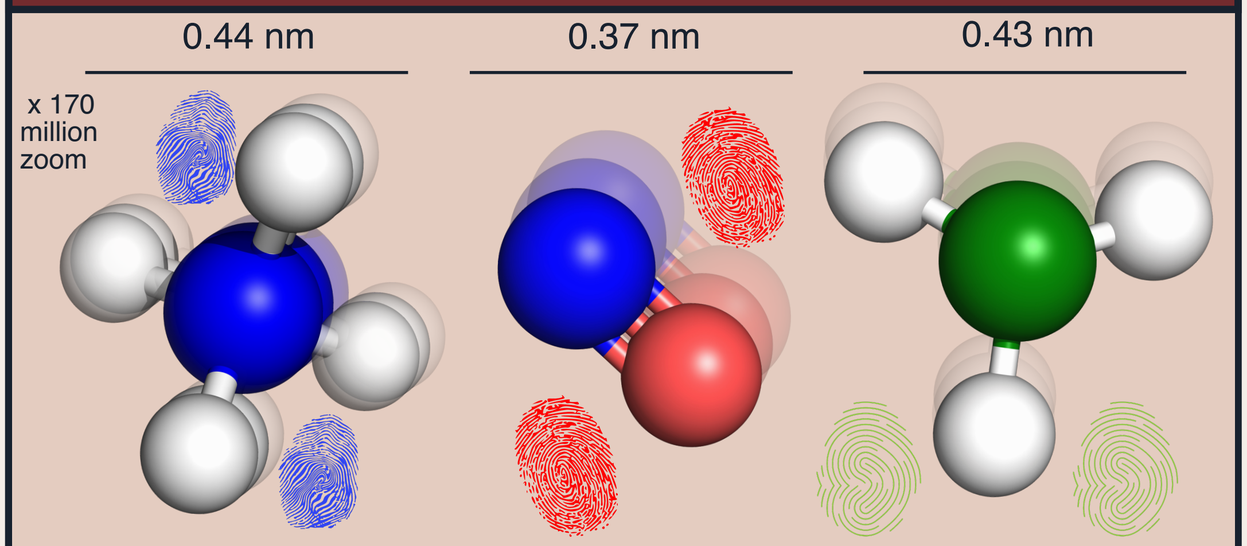
CAN POROUS SEMICONDUCTOR SENSORS MONITOR EXTREME ENVIRONMENTS?

① *Why?* Sensing At The Extreme



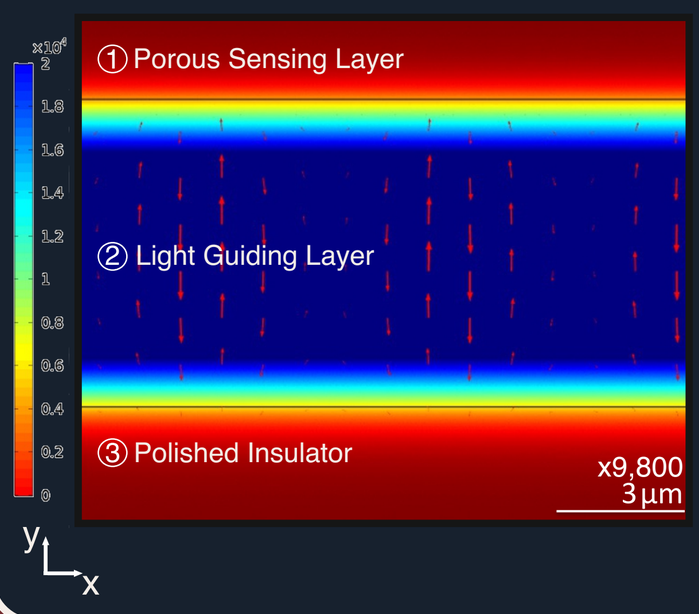
- Sensors degrade in harsh environments, such as space or nuclear facilities, where precise monitoring of chemical changes is ***critical.***
- Detecting gases is particularly ***challenging*** due to size and concentration - methane is 250,000x smaller than a human hair!
- Semiconductor sensors with ***engineered pores offer a solution***: ***enhancing light based sensing***, extending sensor lifetime and simplifying manufacture.

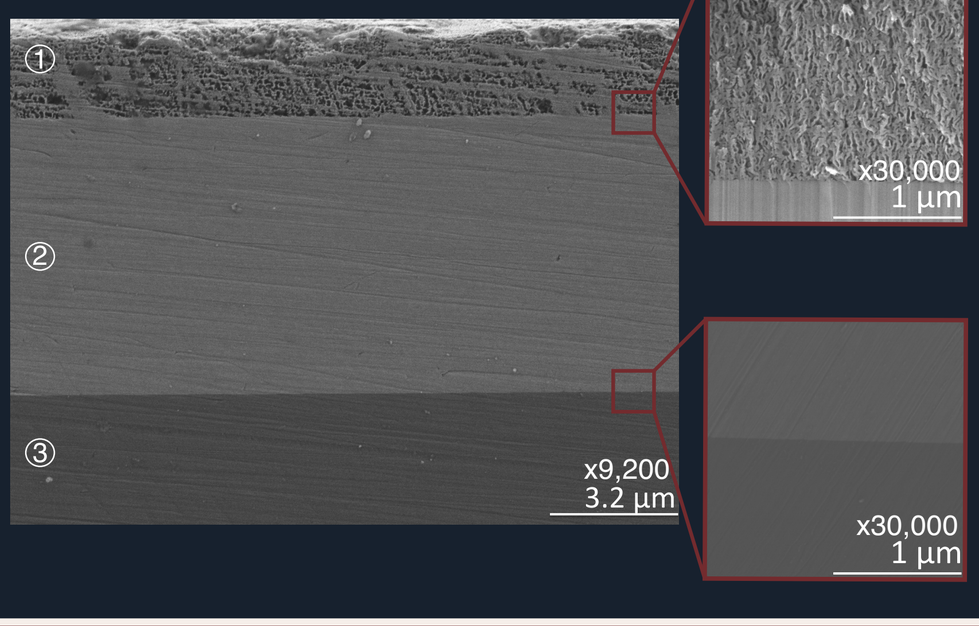
② *How?* Vibration Fingerprints

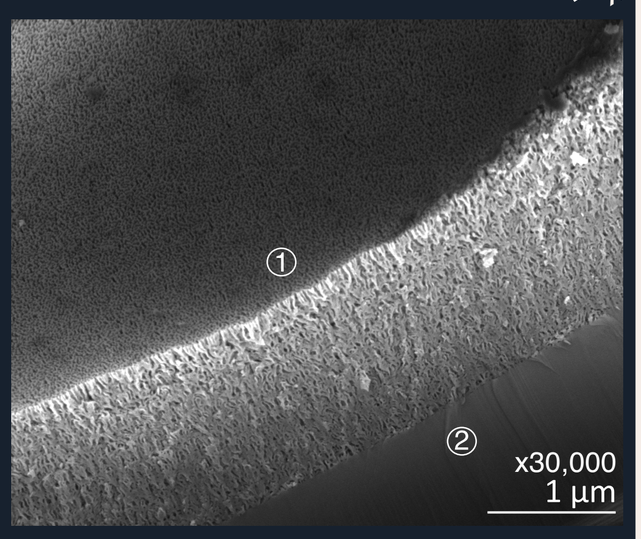


- Gas molecules ***vibrate*** when they ***absorb light***, leaving a unique ***fingerprint like frequency signature***.
- Different molecules ***absorb different frequencies*** of light.
- Using ***mathematical models*** and ***simulation tools***, alongside ***practical experiments***, we are able to ***design bespoke sensors*** that target these frequencies and accurately identify the molecules present.

From heatmap simulations...





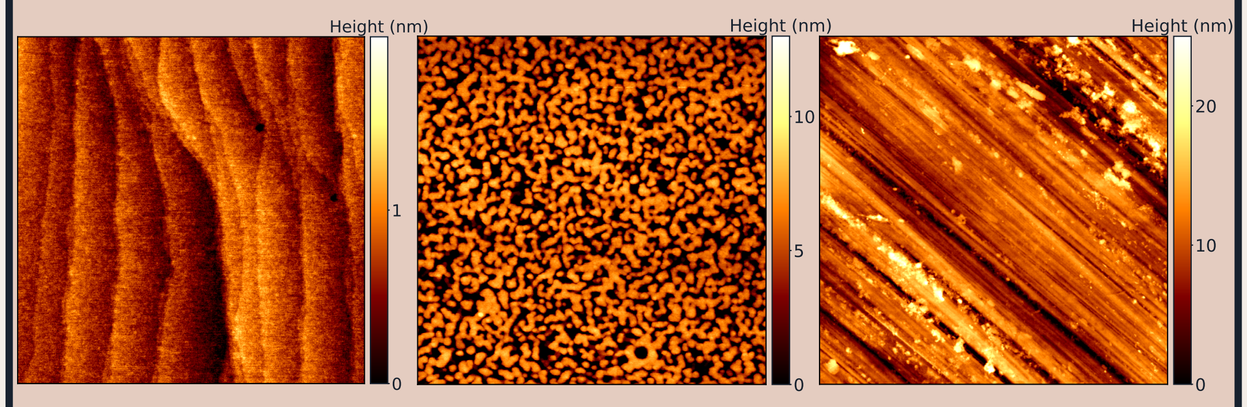


...to fabricated devices

Pores for thought:

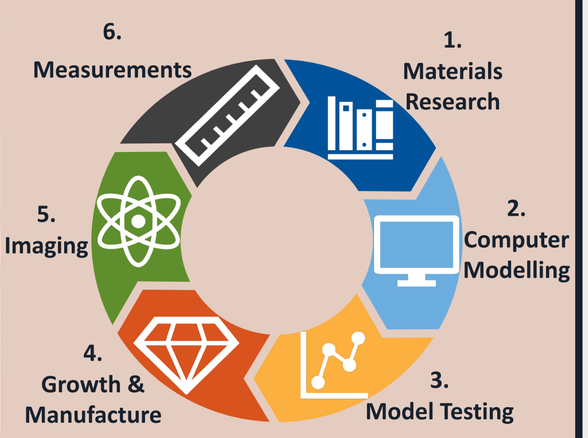
Sensors using porous semiconductors increase the surface area available for interaction and bring molecules closer to where the signal is strongest.

③ *GaN:* The 'Holey' Grail?



- Gallium nitride ***(GaN)*** is ***the ideal semiconductor*** for extreme sensing.
- It is ***physically durable***, ***radiation resistant*** and ***transparent*** at the frequencies we care about for molecular sensing.
- ***Nanoscale imaging techniques*** help turn simulations into devices. Imaging between experimental steps informs material production, pore size, and polishing the final product - ready for light injection.

④ *What Next?* Measure, Analyse, Repeat



- Porous GaN sensors have been ***measured*** to confine and guide light ***for enhanced interaction with gas molecules***.
- Further simulations, targeting of different molecules, and device performance under extreme temperatures and radiations are being studied by ***our research group*** and collaborators. Find out more here:

Cambridge Centre for Gallium Nitride

University of Cambridge

Sivaloganathan Kumaran
(Goes by Kumaran)
sk2077@cam.ac.uk