RADICAL

A FUNDAMENTAL BREAKTHROUGH IN DETECTING ATMOSPHERIC RADICALS

Prof. Justin Holmes, University College Cork

The RADICAL project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 899282.

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Who Am I?

Email: j.holmes@ucc.ie
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Web: www.ucc.ie/en/mcag/

Professor of Nanochemistry
University College Cork (UCC), Ireland

Academic Experience

- > 25 yrs in materials chemistry and nanoscience
  - Research on new (nano)materials for electronic, energy & environmental applications

Commercialisation Experience

- Co-founder of the UCC spin-out company Glantreo in 2006
- Have worked with & licensed technology to large & small companies

My Motivation

To use my knowledge and experience to develop environmental technologies that will benefit the health and well-being of all citizens.

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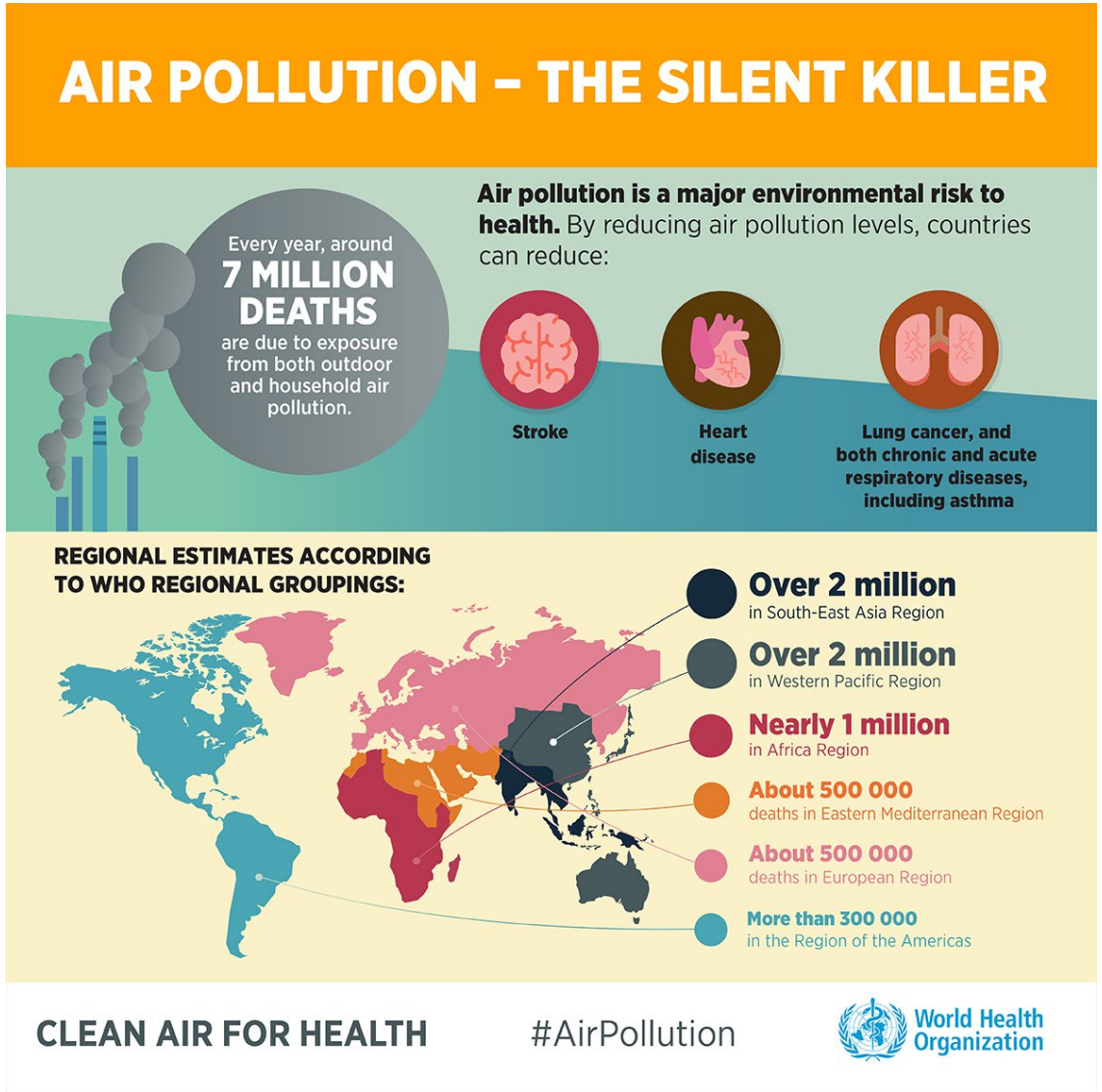
Air Pollution



"Air pollution is the single greatest environmental health risk"

- World Health Organization

Atmospheric radicals: "Detergents of the atmosphere"

- Paul J Crutzen, Atmospheric chemist & Nobel Prize winner

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Challenge of Detecting Radicals

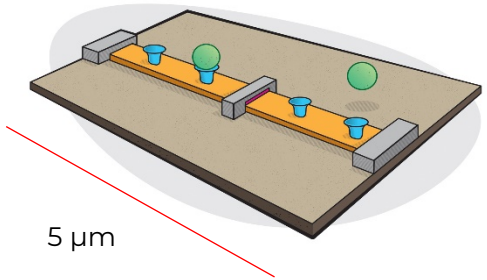
NOW

- Currently, detecting radicals is complex, cumbersome and expensive
- Only a few labs worldwide can detect radicals

1.5 m

FUTURE

- RADICAL is developing a break-through way of detecting radicals with a small, low-cost electronic sensor that can be deployed globally
- This will revolutionise how we understand and model these key drivers of air quality



5 µm

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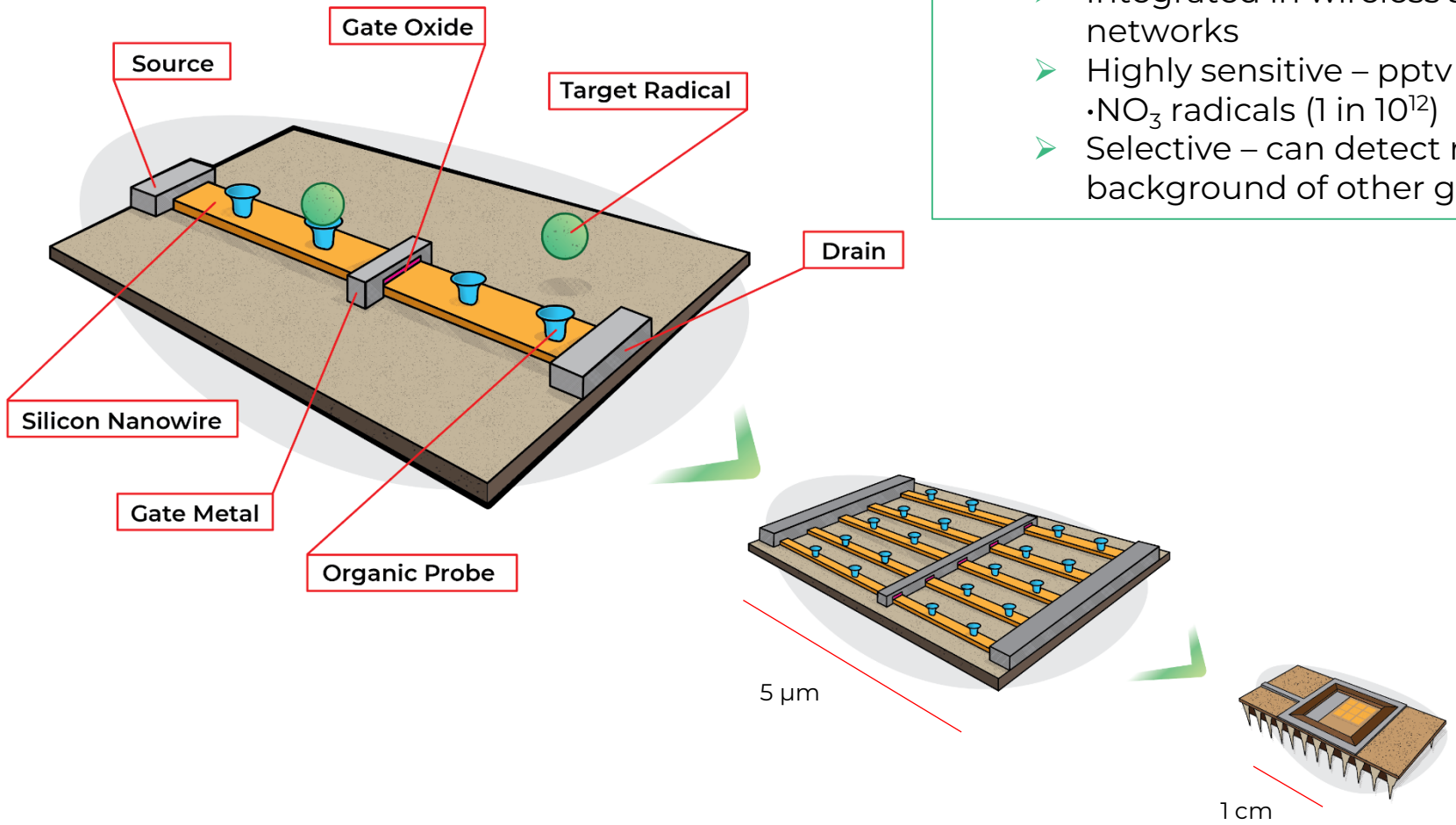
Electrically Detecting Radicals

FUTURE RADICAL SENSOR



RADICAL Sensors

- Low cost – Si platform
- Fast detection
- Integrated in wireless sensor networks
- Highly sensitive – pptv for ·OH and $\cdot NO_3$ radicals (1 in 10^{12})
- Selective – can detect radicals in a background of other gases

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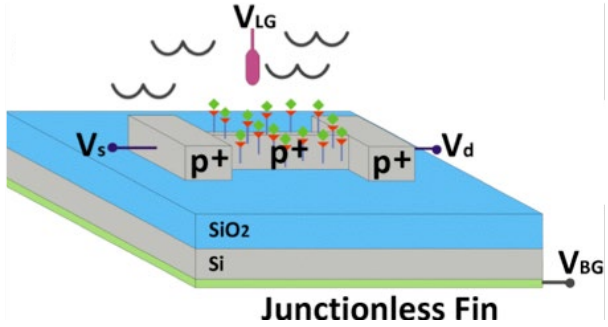
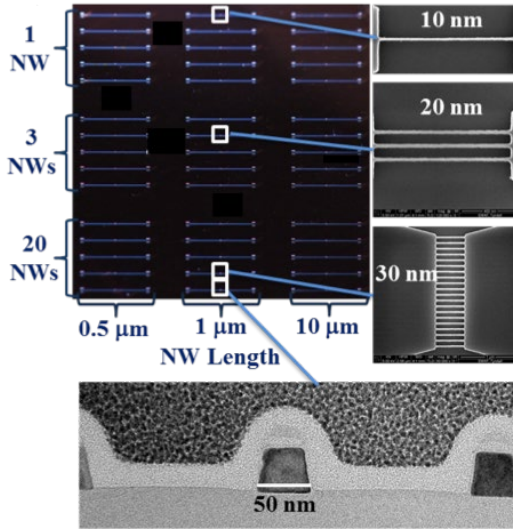
Building an Electronic Nose

2014-2019 – Silicon nanowire sensors to detect proteins in liquids





Streptavidin:

- 580 zM (580×10^{-21} M)
- Approaching single molecule detection

Georgiev, Y. M. et al., Nanotech., 2019, 30, 324001.

2020-2024 – Silicon nanowire sensors to detect radicals in gases (the atmosphere)

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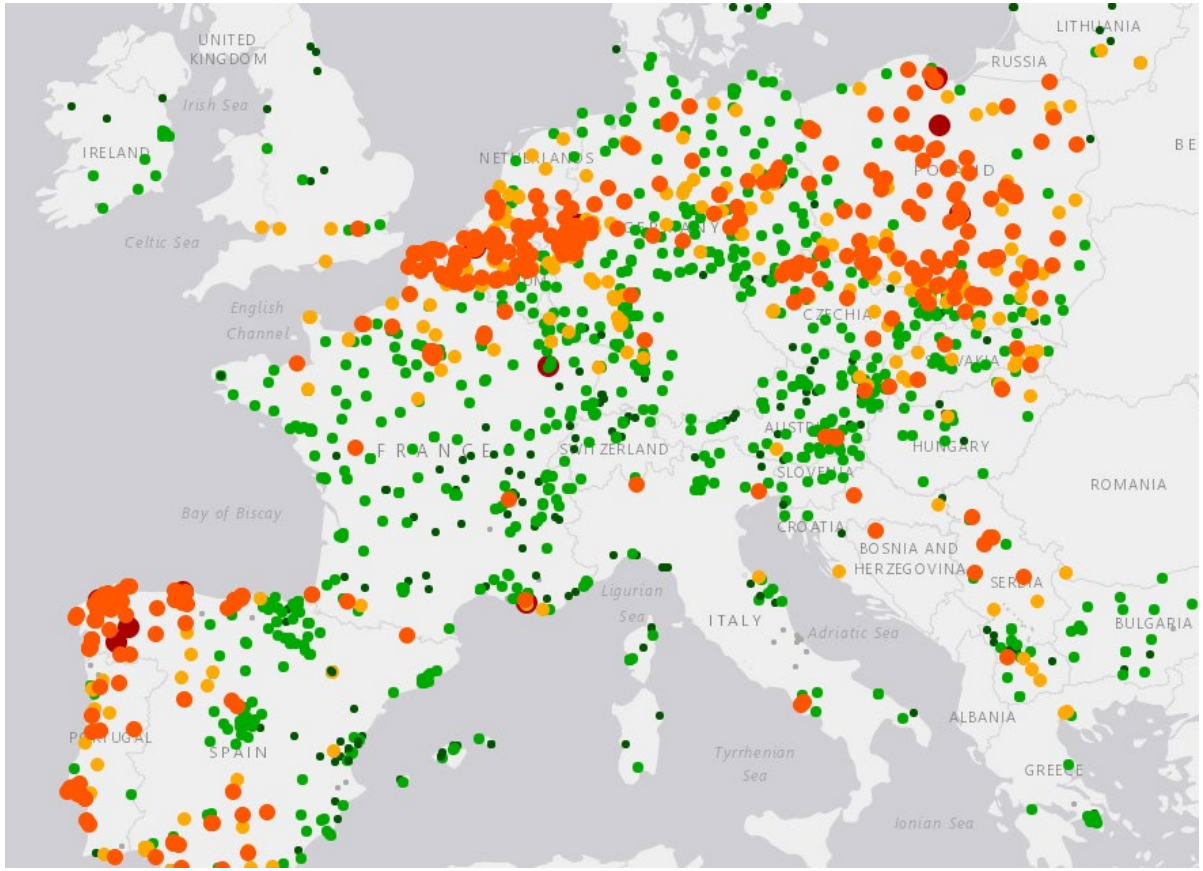
Future Vision

- Radical sensors in use across global networks of air quality monitors
- Better understanding of the role radicals play in air quality regulation
- Improved air quality forecasting and mitigation
- Spin-off applications for low-cost radical gas sensors



Air quality map from the European Environment Agency

- Extended into other areas:
  - *Other environmental pollutants – ammonia, NO_2, SO_2.*
  - *e-health applications - monitoring radicals in the human body*
  - *Food security & surveillance*

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- Want to know more?
- Interested in collaborating?
- Interested in the technology?

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