



UK Fuel Cell Research: a brief overview

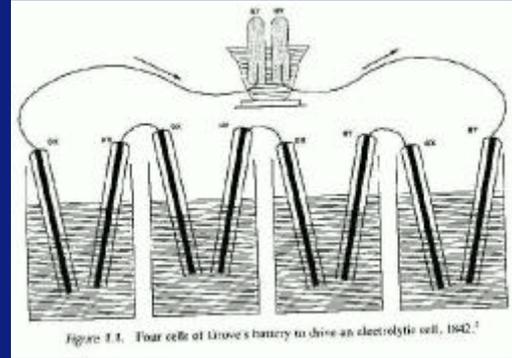
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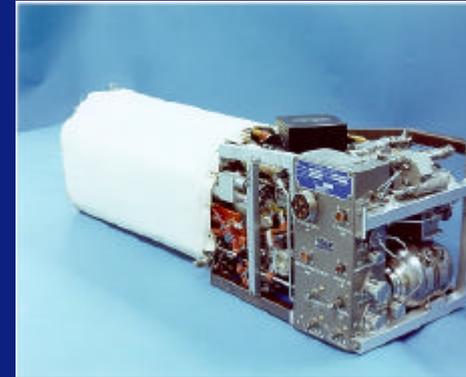
Fuel cell research in the UK has a long history

- Sir William Grove invented the fuel cell in 1839
- Francis T Bacon developed the basis for the fuel cells that powered Apollo and Gemini
- Shell produced a fuel cell vehicle in 1966



Grove's 'voltaic battery'

Space shuttle fuel cell
Courtesy UTC Fuel Cells



Shell DAF 44

Courtesy Shell Research and WFCC

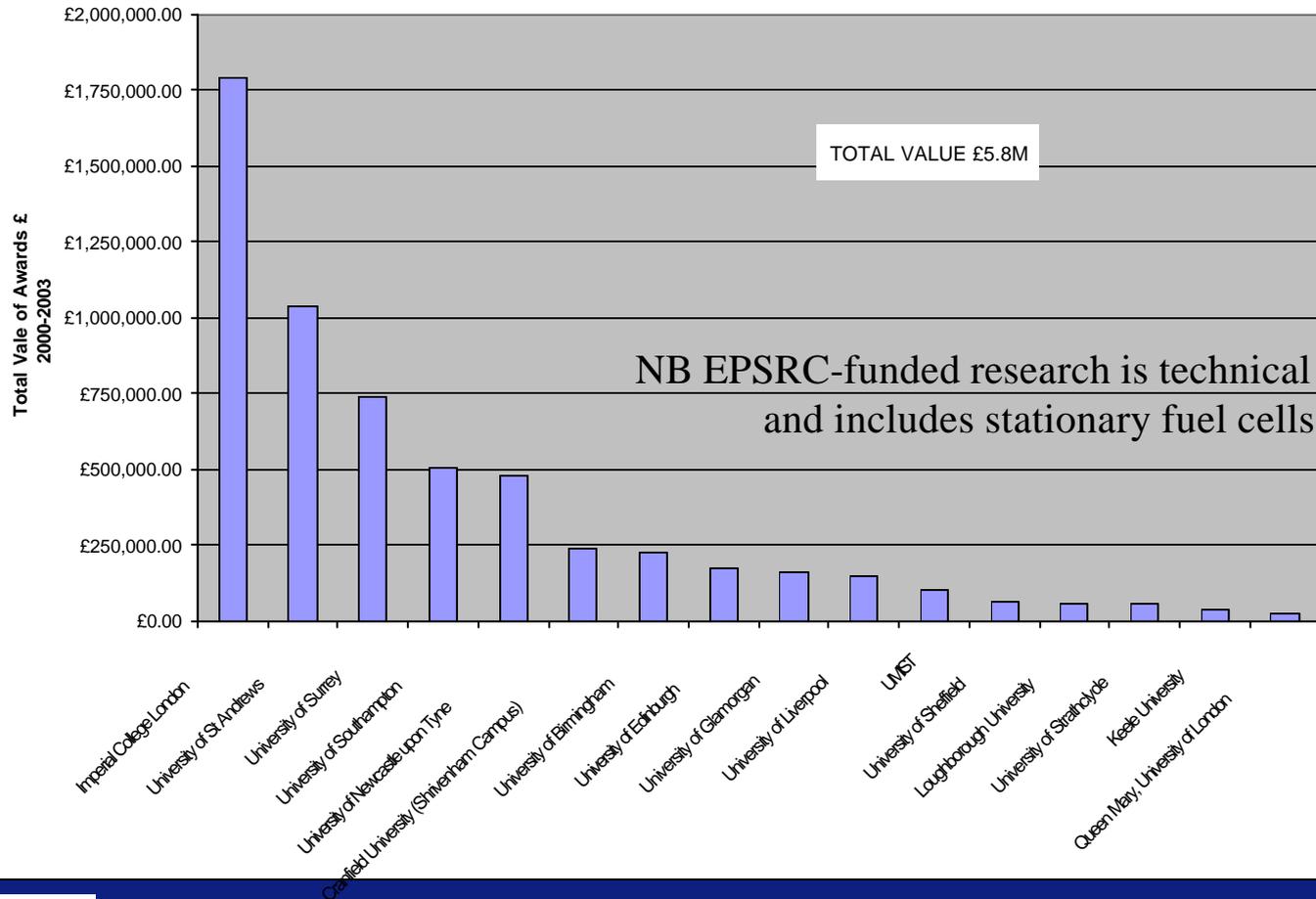


UK fuel cell research has broadened from a primary focus on fundamental science

- EPSRC has funded fuel cell basic research in Universities
- DTI has given R&D support since 1992 – from paper studies to systems development
- ESRC is funding socio-economic analysis
- Carbon Trust also has fuel cell projects, but less research-focused
- UK organisations are also well-placed in European projects

Academic fuel cell research in the UK is concentrated in pockets of excellence

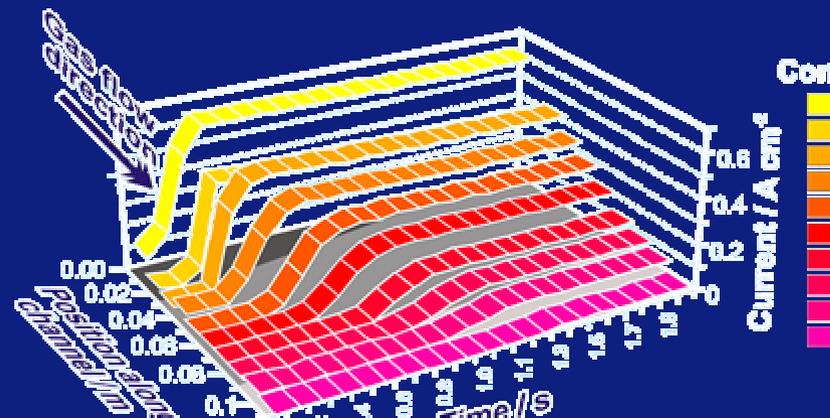
EPSRC Support Of Fuel Cell Projects With Research Establishments
Total of Grants Awarded 2000-2003



Current UK fuel cell research has several areas of strength

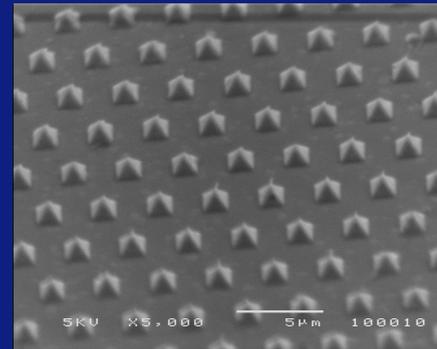
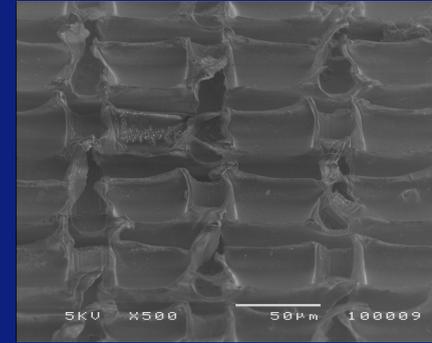
- PEM and SOFC are the primary focus
- Materials research is strong
- Chemistry and Electrochemistry are also areas of excellence
- The UK has additional expertise in socio-economic and policy research

Characterising
PEM fuel cells



PEM research covers a range of subjects

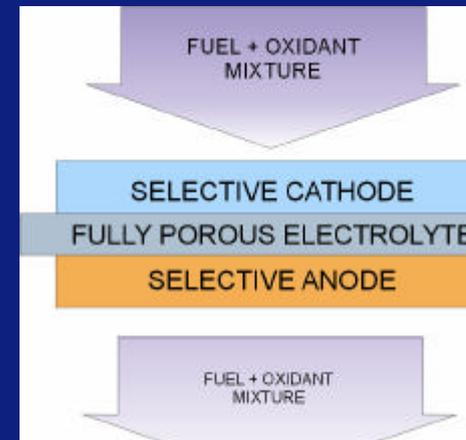
- Improved catalysts and catalyst processes (e.g. Imperial, Southampton, Cranfield)
- Polymer and membrane development (e.g. Newcastle, Imperial)
- PEM systems (e.g. Loughborough)
- Direct Methanol (DMFC) systems (e.g. Imperial, Newcastle, Surrey, Liverpool)
- Many of these could or do have automotive relevance



SEM images of structured Nafion interfaces

Other relevant fuel cell research is in IT-SOFC and other areas

- Solid oxide fuel cell research is strong in the UK but less relevant to transport applications
- However, intermediate temperature solid oxide fuel cells could be used for APUs
- IT-SOFC work is very strong at Imperial, using various fuels
- Mixed reactant fuel cells also offer a new perspective (e.g. Newcastle)



A mixed reactant
fuel cell

Other research supports the technical development of fuel cells themselves

- The potential for alternative fuels in fuel cells has been examined (e.g. Imperial, Birmingham, Loughborough)
- Hydrogen infrastructure modelling is underway (Imperial)
- Innovation systems are being characterised (City)
- Public acceptance of fuel cell technologies is under detailed consideration (Imperial)
- Policy and strategy research is also ongoing (various)

UK fuel cell research is concentrated and of high quality

- Industrial organisations play an essential and active role with Universities
- Several fuel cell companies have been spun out of university research
- Bigger players also rely on universities for some of the fundamentals
- International partnerships are also important
 - Work with Japanese organisations is strong in both fuel cells and hydrogen energy