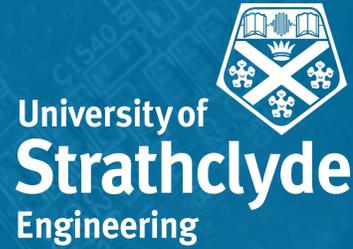


Sustainable Materials for Hydrogen

Related Technologies

Stephen M. Lyth

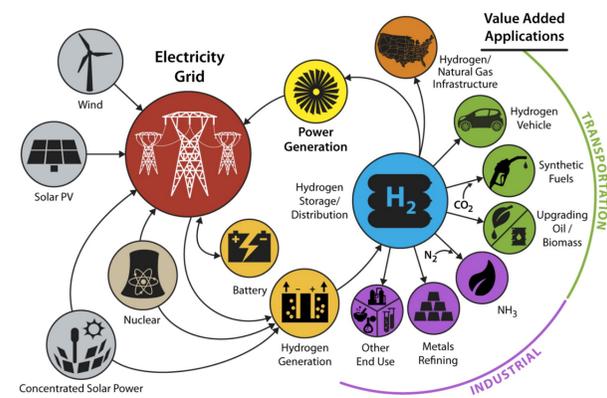
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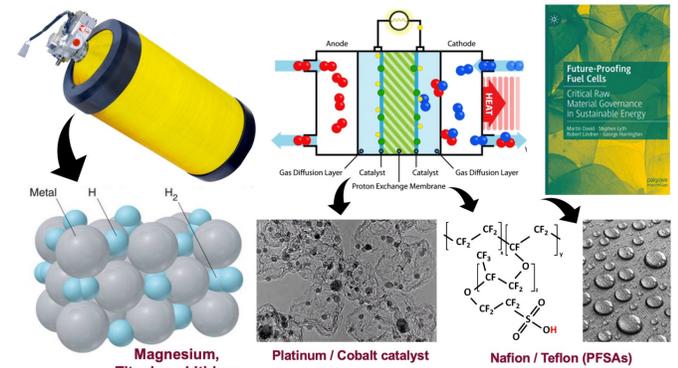
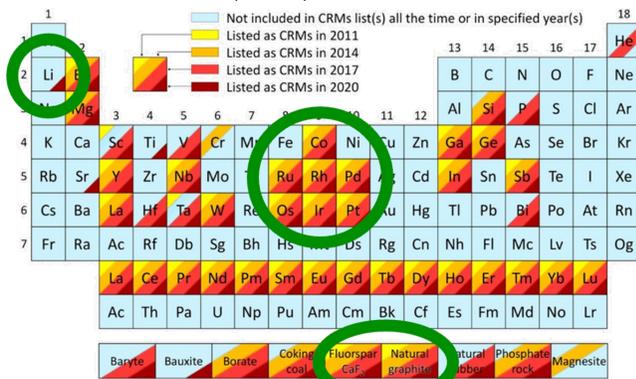
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Introduction



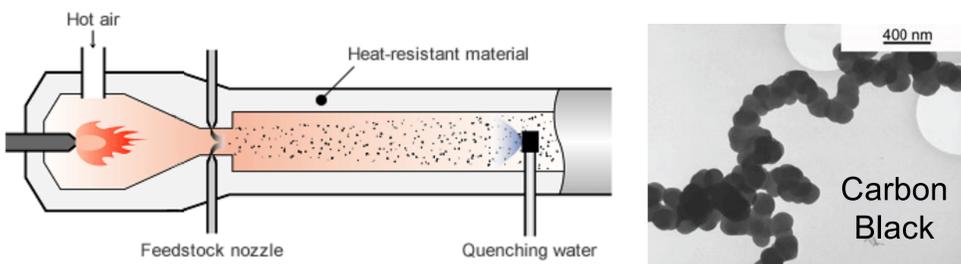
The Hydrogen Economy will help society move away from our dependence on fossil fuels, and achieve Net Zero by 2050.

Many renewable technologies rely on inherently unsustainable critical raw materials (CRMs), such as cobalt in Li-ion batteries.



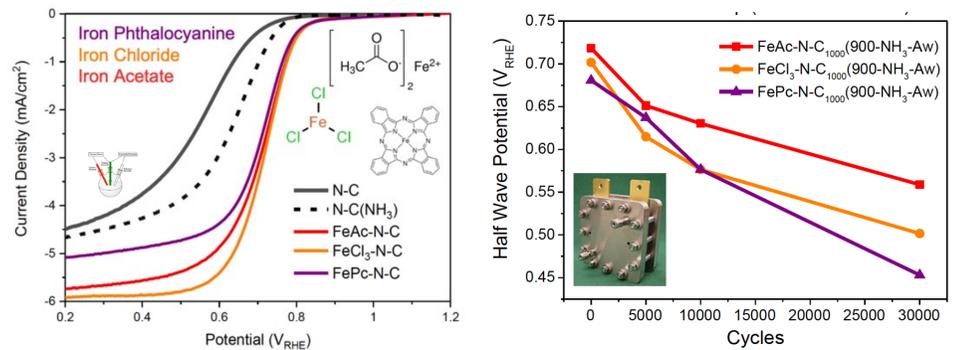
We must act now to avoid the establishment of CRM-related path dependencies in hydrogen and fuel cell related technologies!

Unsustainable Carbon Materials



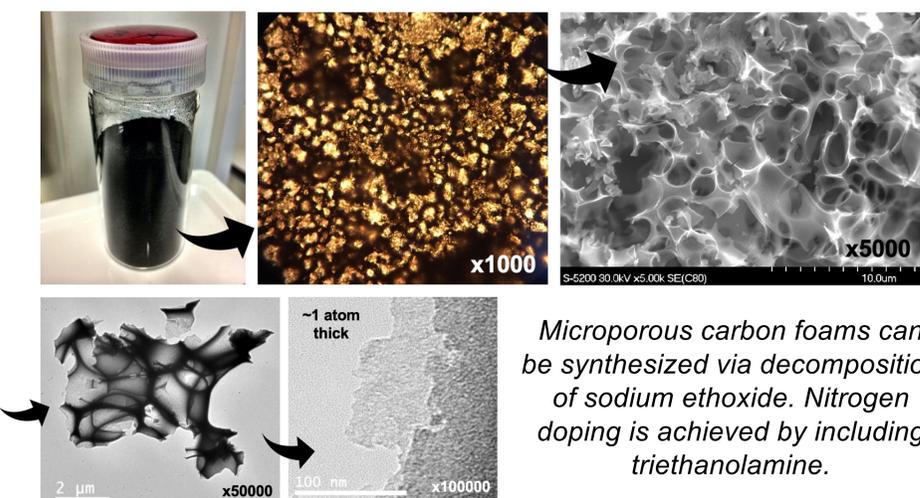
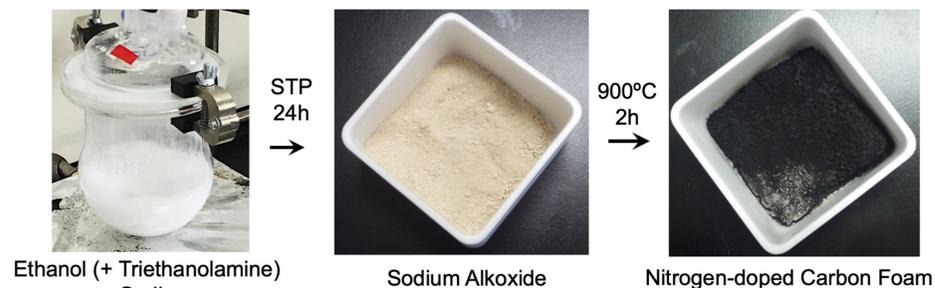
- Graphite is classed as a **critical raw material** by the EU.
- Carbon fibre is made by heating **petrochemicals**.
- Carbon black is obtained from **coal tar** or **petroleum**.

Platinum-free Electrocatalysts



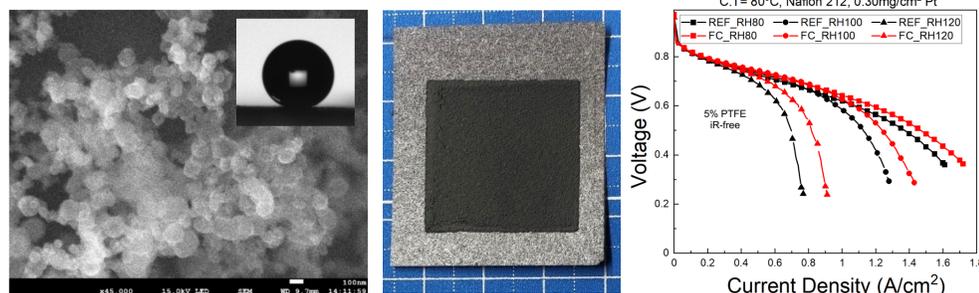
Nitrogen-doped carbon foams decorated with transition metals can act as efficient and durable oxygen reduction reaction electrocatalysts.

Ethanol-derived Carbon: Microporous Foams



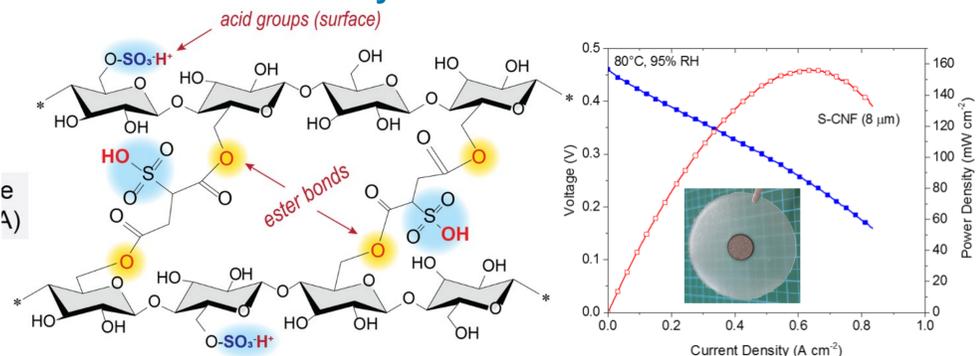
Microporous carbon foams can be synthesized via decomposition of sodium ethoxide. Nitrogen doping is achieved by including triethanolamine.

Fluorinated Carbon Gas Diffusion Layers



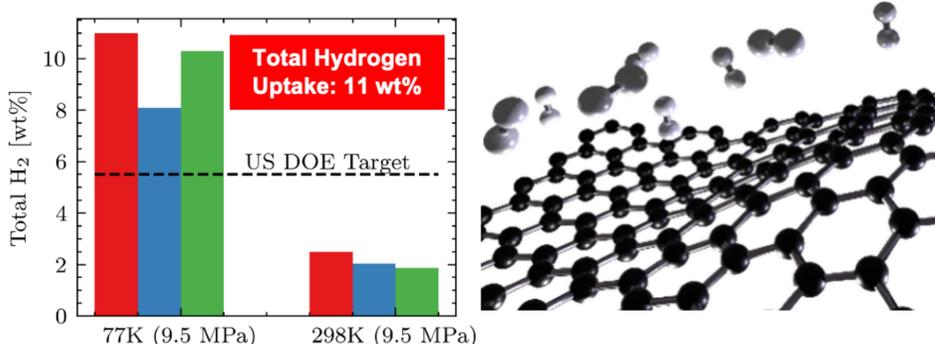
Fluorinated carbon nanoparticles are superhydrophobic. They can be used as the microporous layer in fuel cells, resulting in improved performance at high current density, due to enhanced water repelling properties.

Nanocellulose Electrolyte Membranes



Nanocellulose (e. g. cellulose nanocrystals) can be used as a sustainable alternative to sulfonated fluoropolymers in fuel cell membranes.

Hydrogen Storage via Cryosorption



Microporous carbon foams can meet US DOE targets for hydrogen uptake.

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