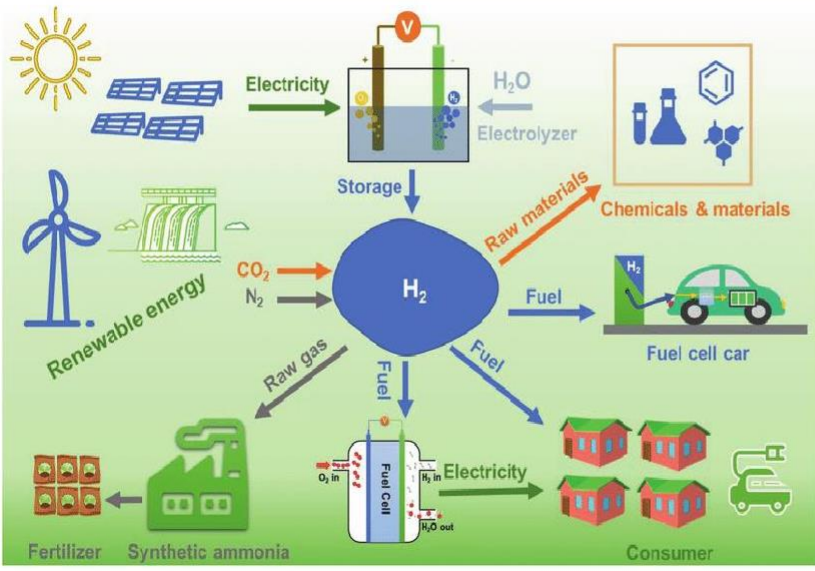




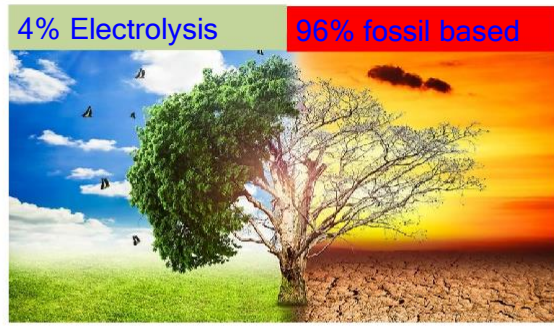
Gudaysew T. YENESEW,

Eric QUAREZ, Annie LE GAL LA SALLE, Clément NICOLLET, Olivier JOUBERT

State of the art of H₂ Economy



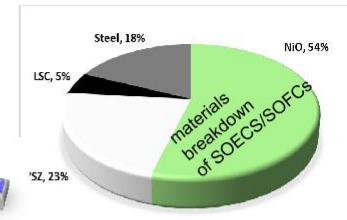
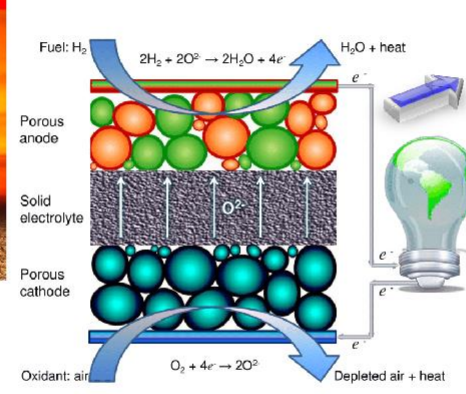
Current hydrogen production



French strategy

- To decarbonise economy
- A massive production of decarbonized hydrogen: x 3000 the electrolysis capacity, 6.5 GW by 2030

How it works



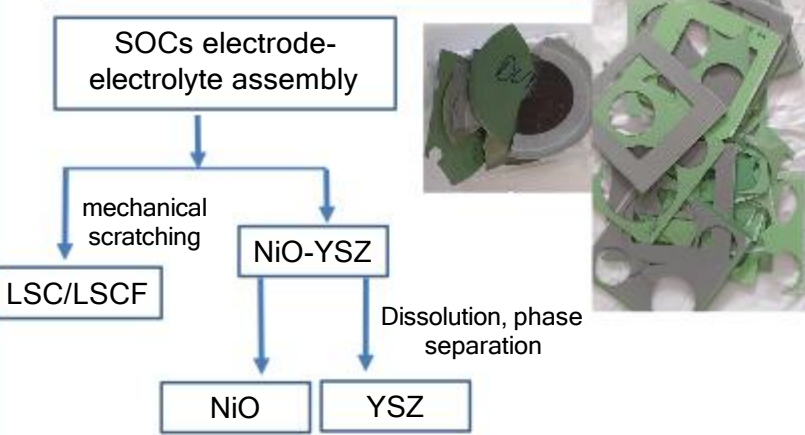
- Large size Electrolyzer demand
- Large amount of waste generated

Objective

Find a Strategic way to Recycle, Recover and Reuse, Solid Oxide Electrolyzers Cells and Fuel Cells waste materials in electrode and electrolyte assembly.

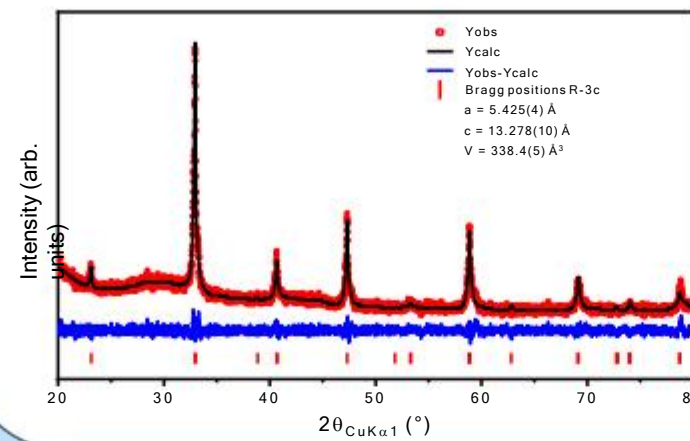


Phase separation

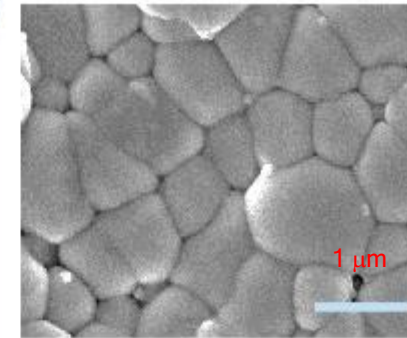


LSC from air electrode

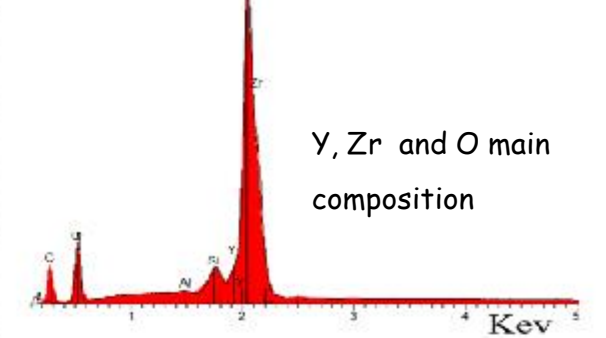
air electrode powder material is easily separated by mechanical scratching



Recovered YSZ densification



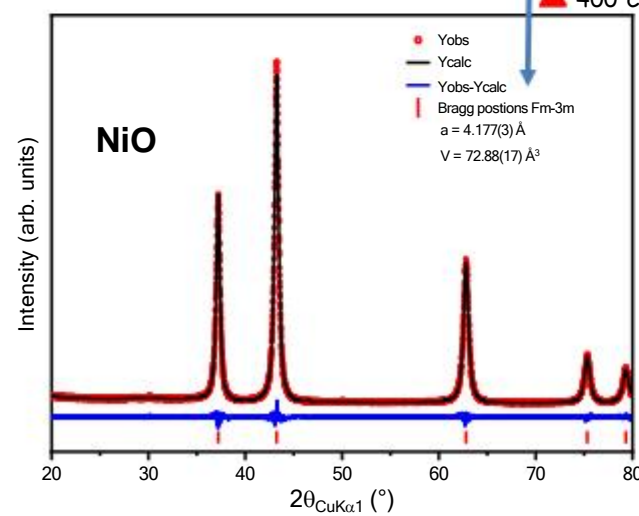
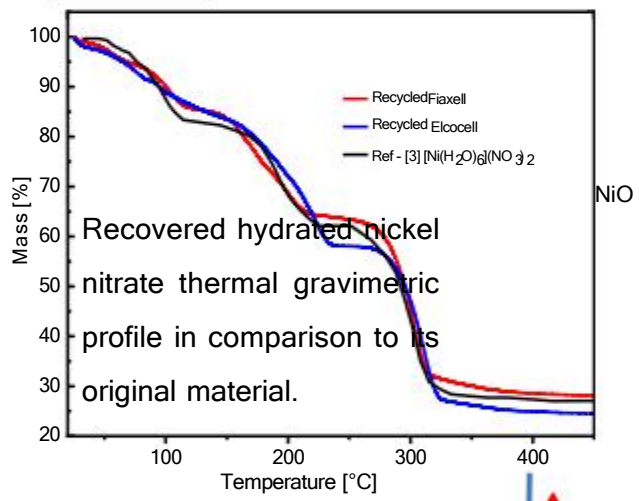
Recycled YSZ powder sintered at 1350°C for 20h: a very dense ceramic (95.5% of relative density)



Si and Al were also detected as an impurity during the EDX analysis in recycled YSZ.

NiO from fuel electrode

Nickel or nickel oxide is dissolved in nitric acid whereas YSZ cannot be dissolved

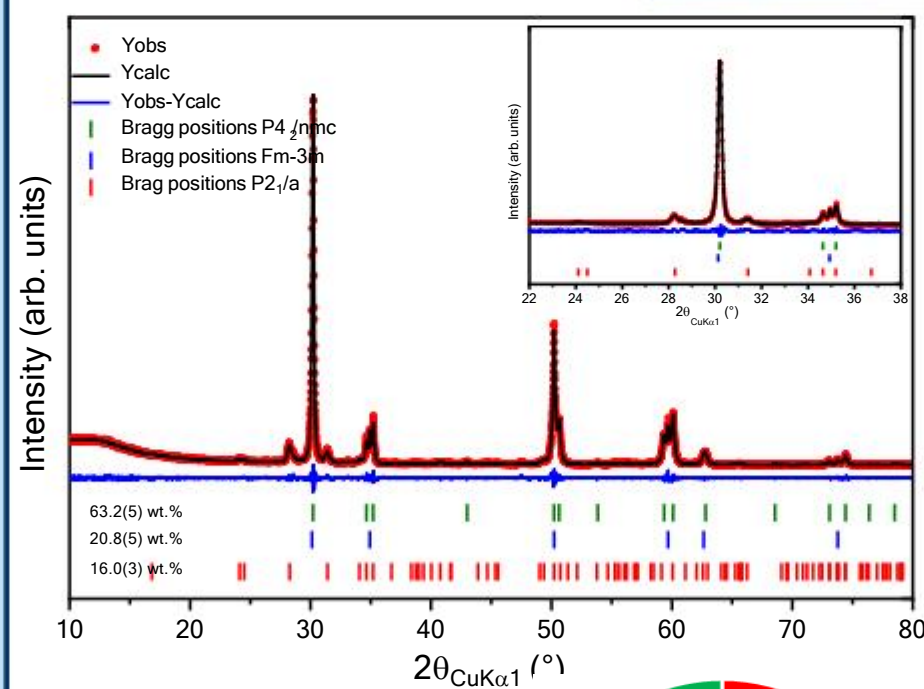


Recovered nickel oxide purity; 98.9 At. % by EDX and 99.4 At. % by ICP-AES

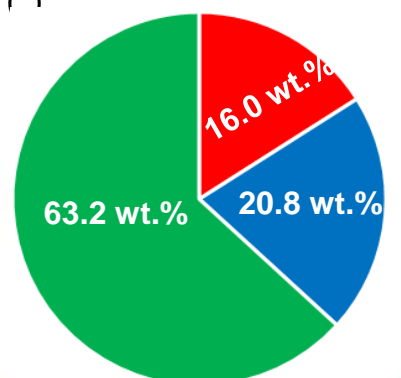
YSZ from fuel electrode and electrolyte

Opportunities

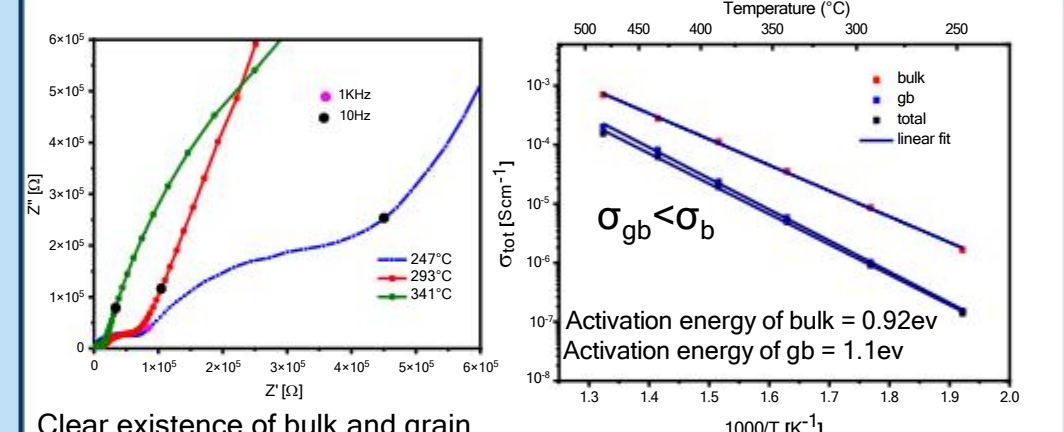
- ✓ Difference of solubility of YSZ and Nickel in acid.



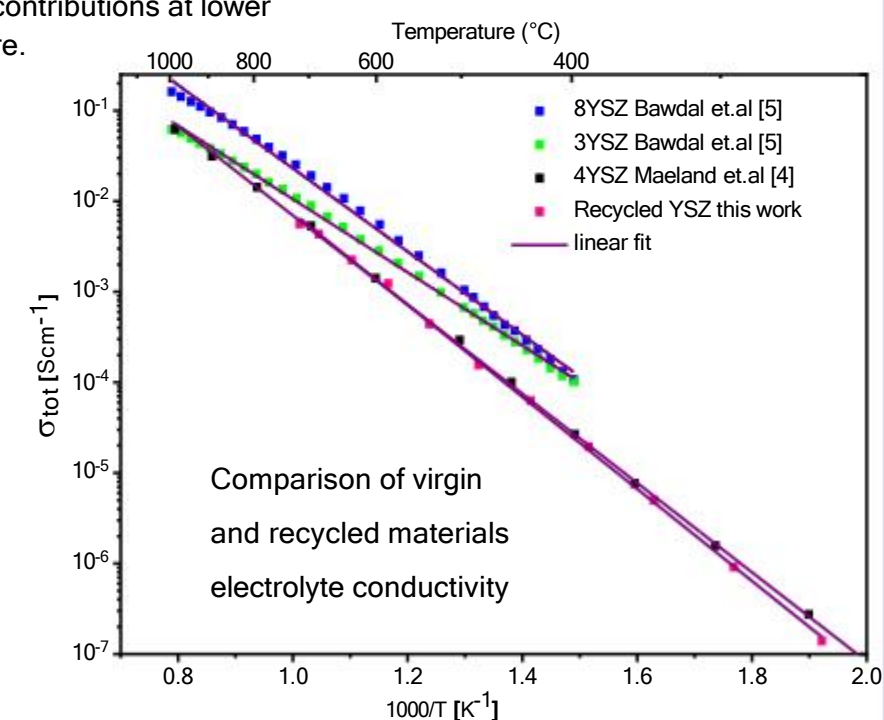
A mixture of 3 YSZ phases with different yttrium content



Ionic conductivity of recovered YSZ



Clear existence of bulk and grain boundary contributions at lower temperature.



- ❖ The conductivity of recovered electrolyte is comparable with 4YSZ from Maeland *et al.* [4]
- ❖ Lower than 3YSZ from Badwal *et al.* [5] this might be due the microstructural difference and the gb blocking effect of Silica.

Conclusions and perspectives

- Successful Separation, Recycling and Recovering of Solid Oxide Cells components
- Air electrode La_xSr_{1-x}CoO₃, nickel oxide, and Zr_{1-x}Y_xO_{(2-x)/2} successfully separated
- Physical and Electrochemical characterizations of recycled compounds
- Total conductivity of recovered electrolyte 4.8 · 10⁻³ S cm⁻¹ at 700°C

- ✓ Increasing the amount of yttrium in the recycled YSZ to 8YSZ which is the most widely used electrolytes in SOFCs
- ✓ Figure out the sources of Si and Al contamination and find a way to reduce or remove it.

References

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