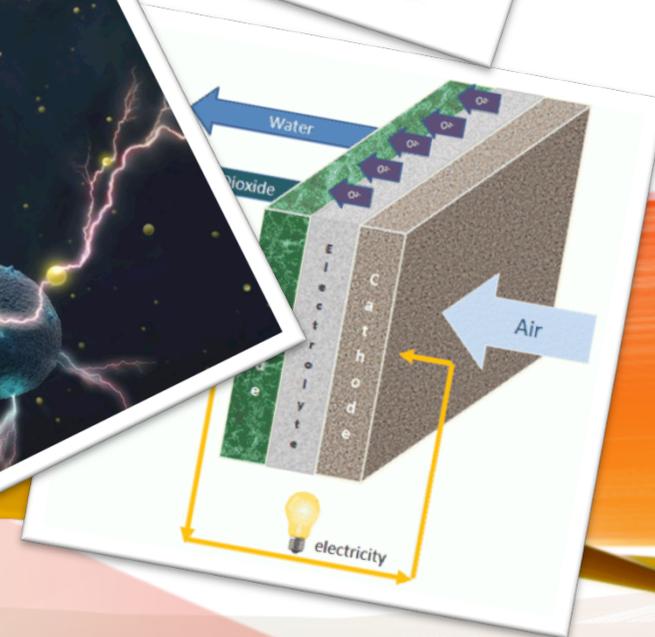


CHIMICA SOSTENIBILE

Stage invernale 11-15 feb 2019



Chimica e ambiente

Economia lineare

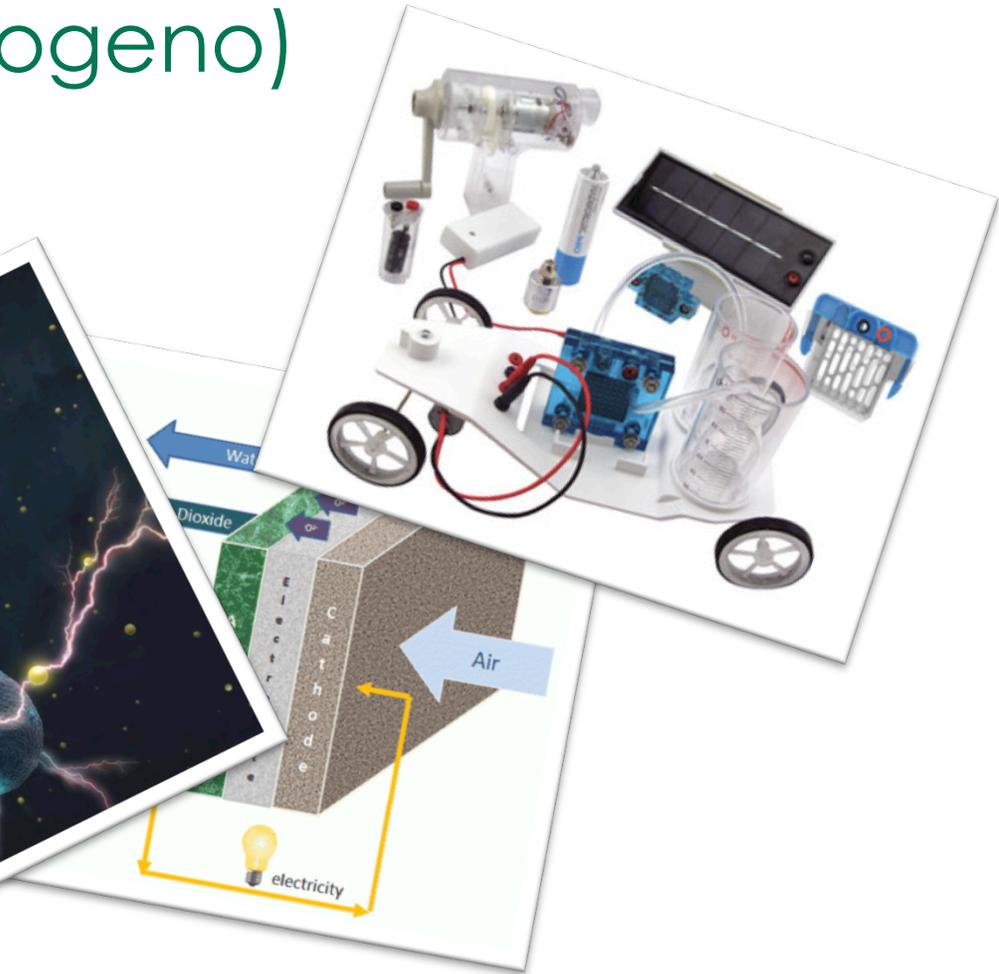
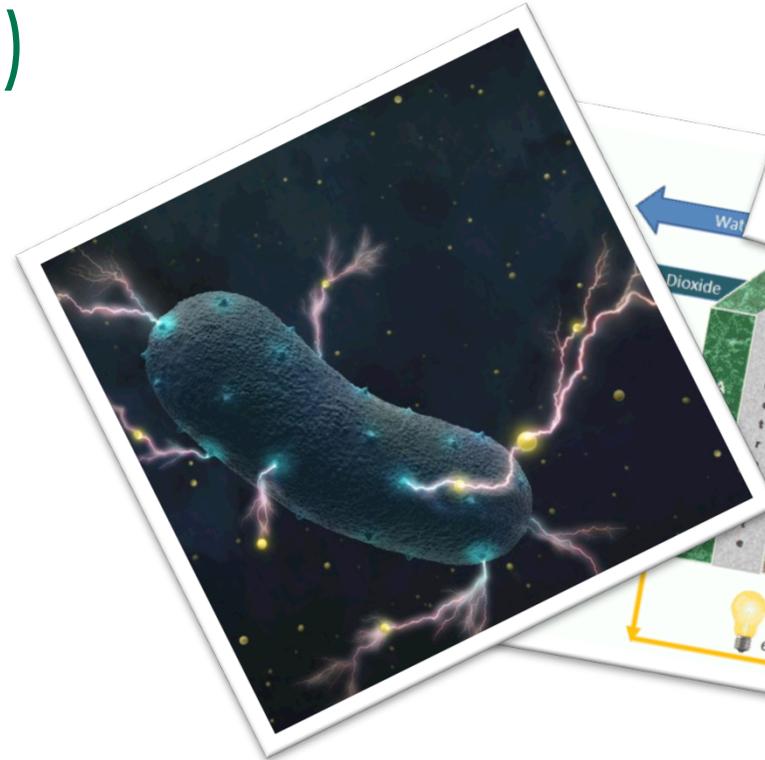


Economia circolare

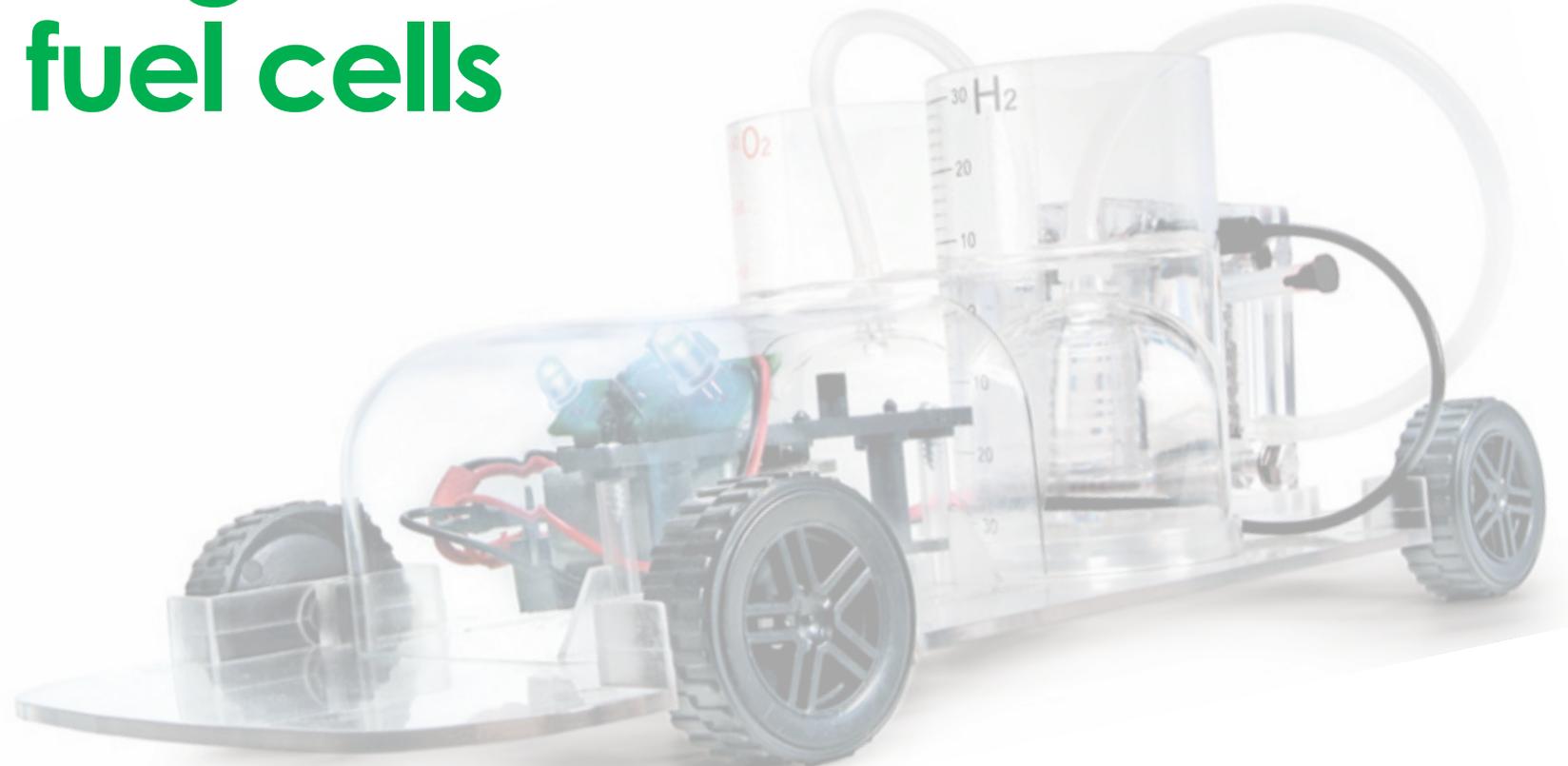


Nuove forme di energia rinnovabile

- Cella a idrogeno (macchina a idrogeno)
- Cella a ossidi solidi (SOFC)
- Cella microbica (MFC)



Proton exchange membrane fuel cells (PEMFCs)



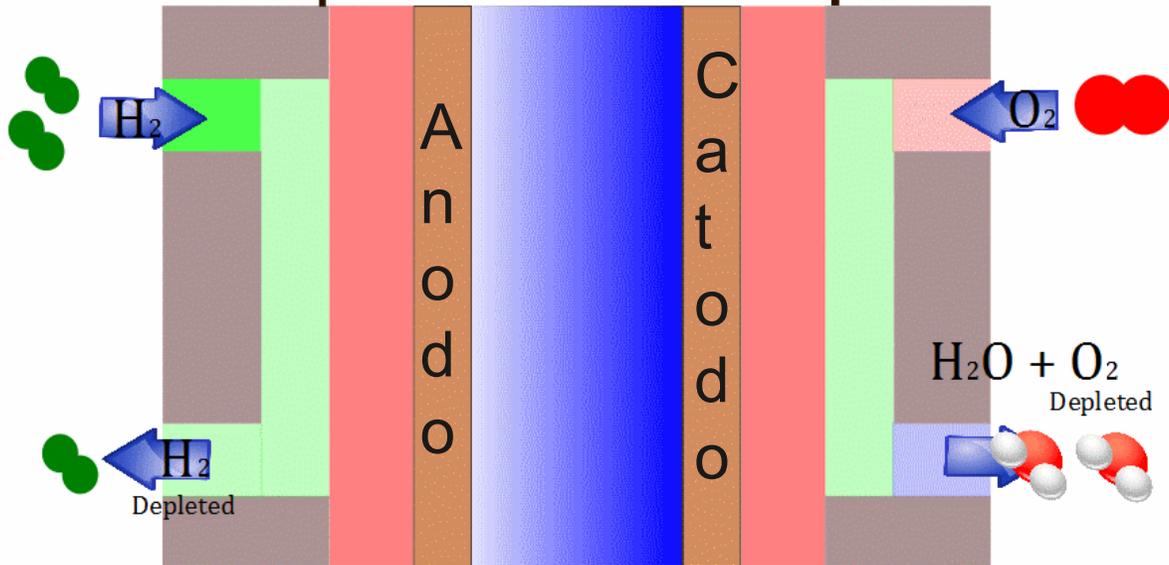
PROTON EXCHANGE MEMBRANE FUEL CELLS (PEMFCs) CELLE A COMBUSTIBILE AD IDROGENO

Tecnologia

Energia chimica → Energia elettrica



COMBUSTIBILE



Alcune applicazioni

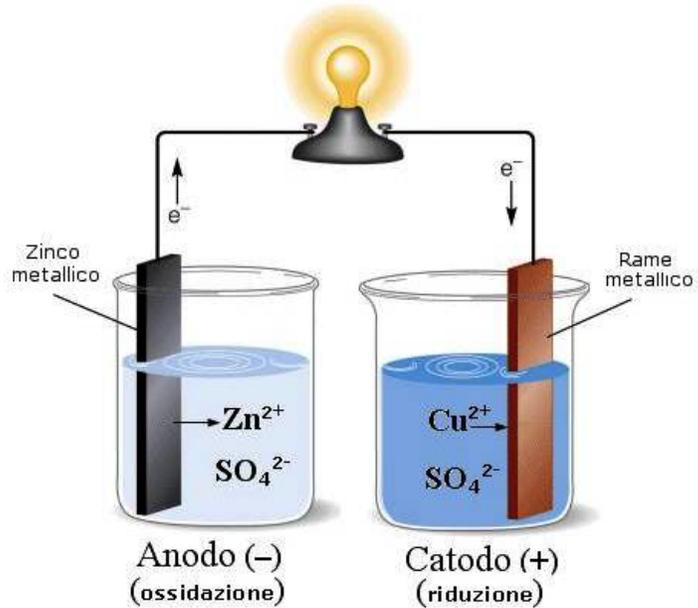


PROTON EXCHANGE MEMBRANE FUEL CELLS (PEMFCs) CELLE A COMBUSTIBILE AD IDROGENO

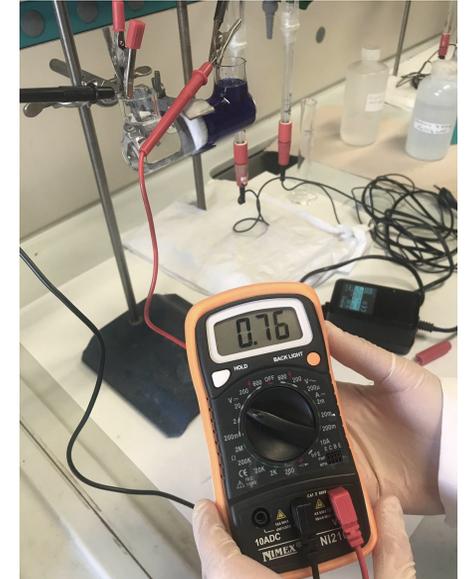
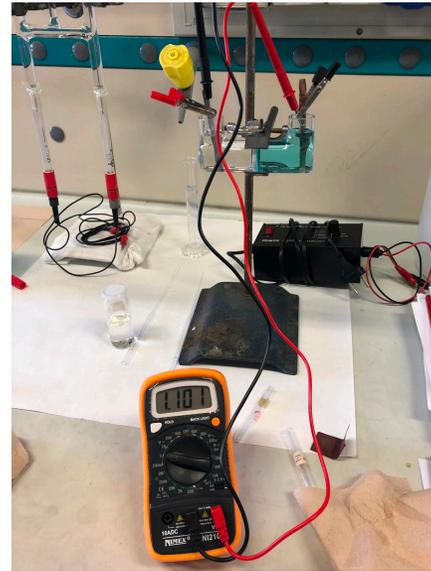
REAZIONE DI OSSIDORIDUZIONE SPONTANEA

Energia chimica → Energia elettrica

PILA DI DANIELL

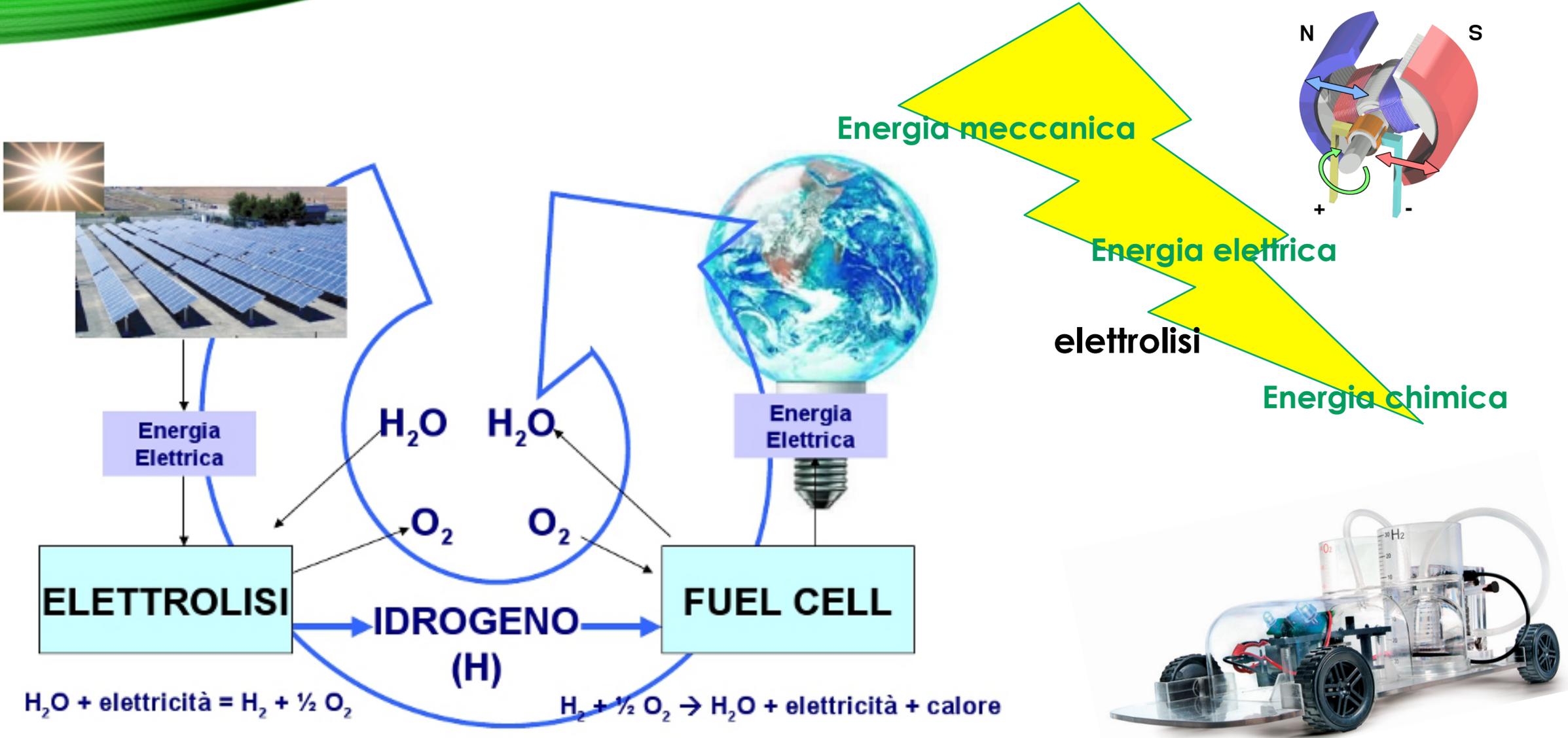


UNO DEI NOSTRI ESPERIMENTI



ammoniaca

Come l'abbiamo fatta partire?

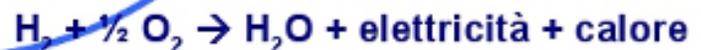


Energia meccanica

Energia elettrica

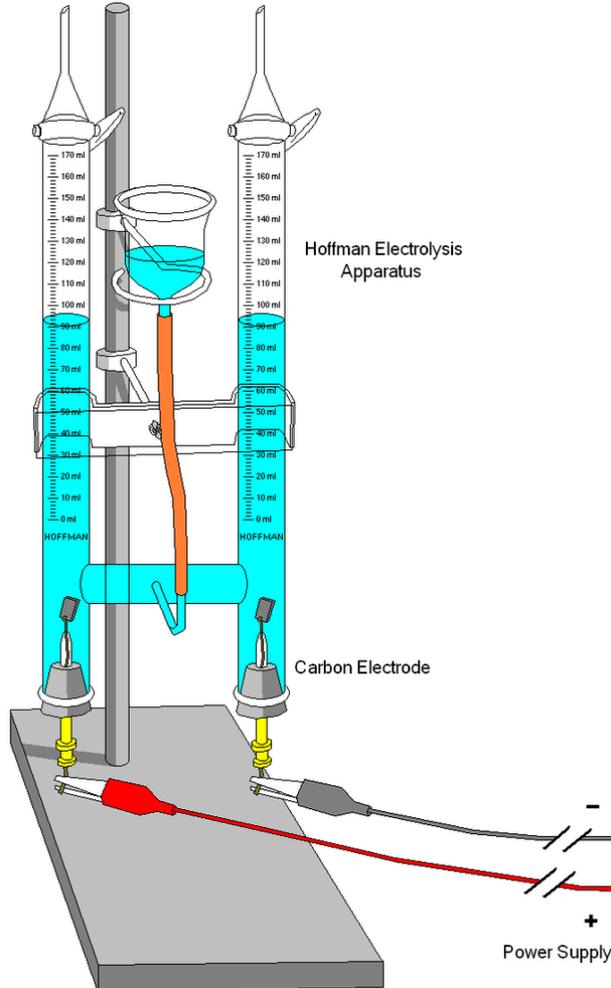
elettricità

Energia chimica



REAZIONE DI OSSIDORIDUZIONE NON SPONTANEA

Tubo di Hoffman

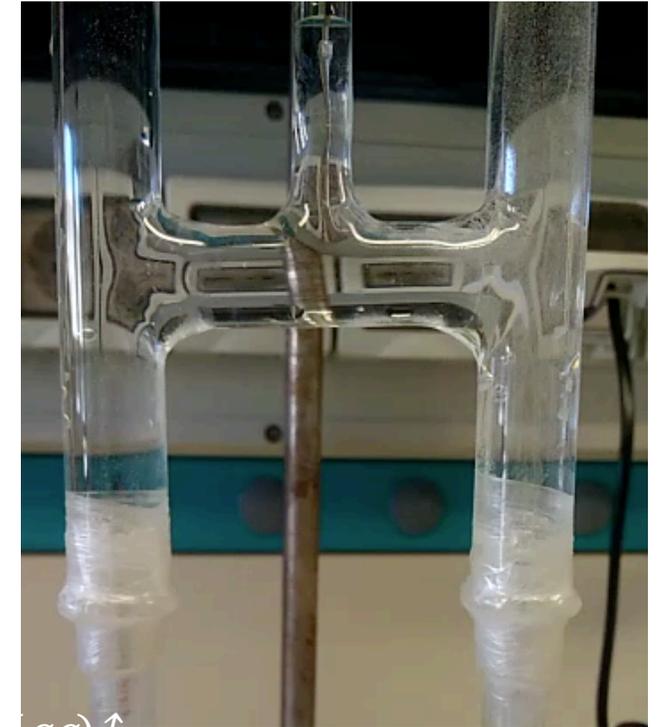


DINAMO (grazie Riccardo)



Da energia meccanica a elettrica

Elettrolisi



PROTON EXCHANGE MEMBRANE FUEL CELLS (PEMFCs) CELLE A COMBUSTIBILE AD IDROGENO

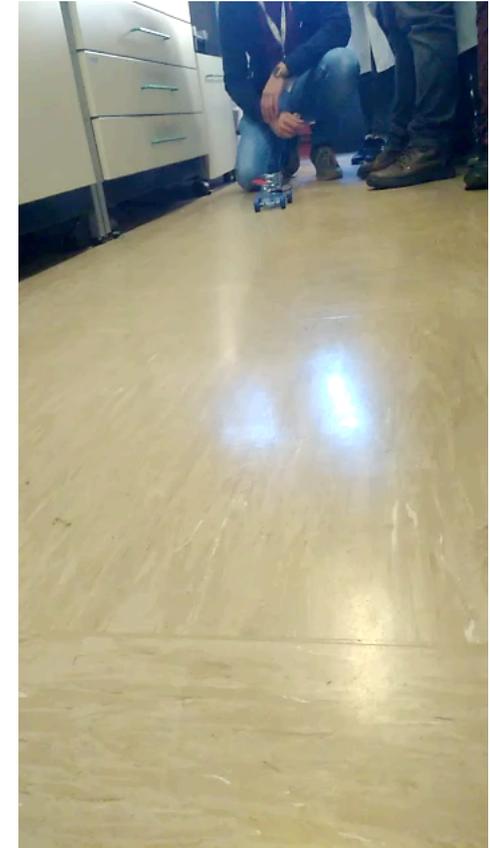
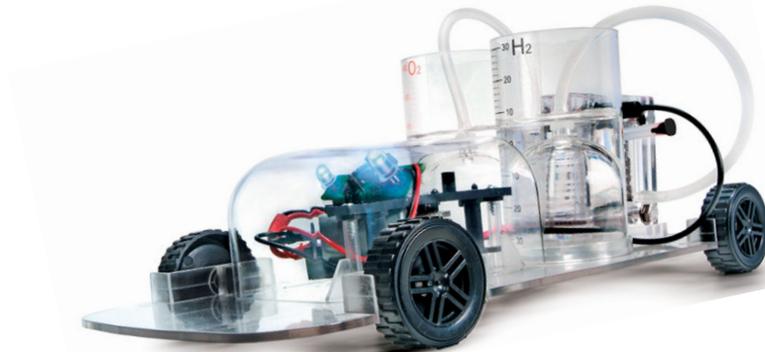
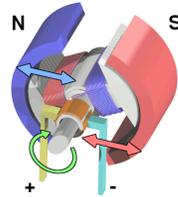
Una tecnologia che porta lontano!

Energia meccanica

Energia elettrica

elettrolisi

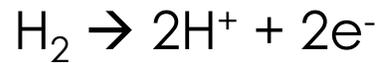
Energia chimica



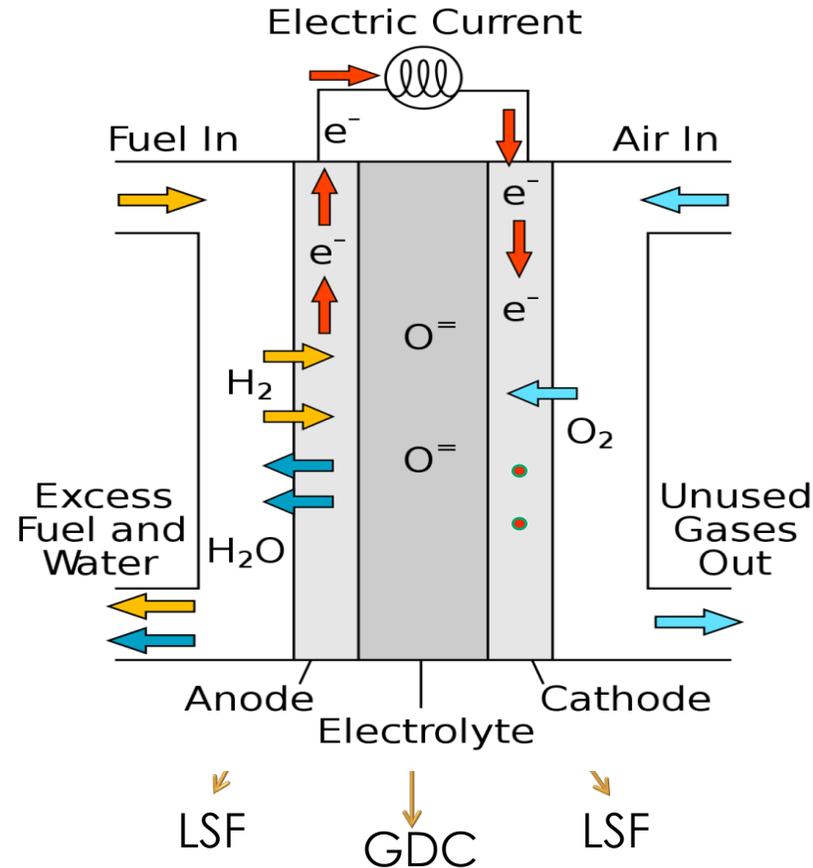
Solid Oxide Fuel Cell

SOFC

Reazione di ossidazione



Reazione di riduzione



$\eta =$
80-90%

SINTESI $\text{La}_{0,6}\text{Sr}_{0,4}\text{Fe}_1\text{O}_3$

Perovskite:

struttura cubica a corpo
centrato
 ABO_3

Reagenti:

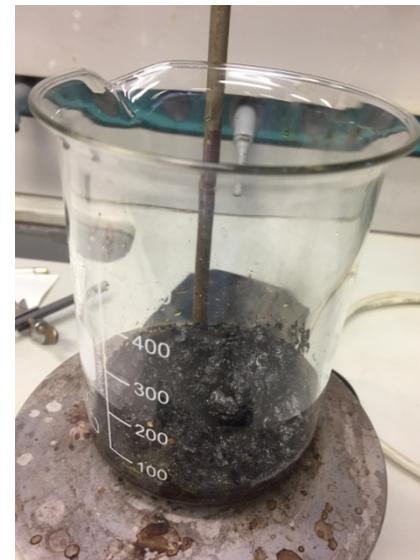
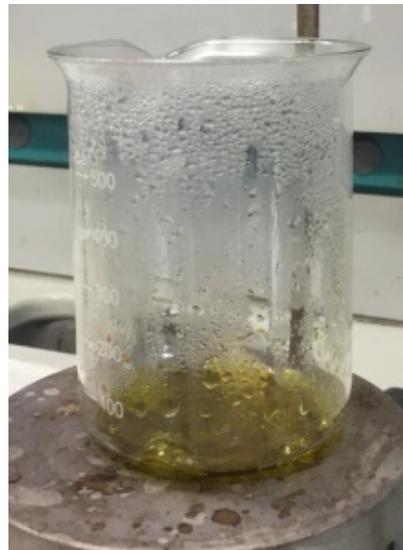
Nitrato di lantanio idrato

Nitrato di stronzio

Nitrato di ferro idrato

Acido citrico (agente
complessante)

Aggiunta NH_4OH , e controllo $\text{pH} = 8$



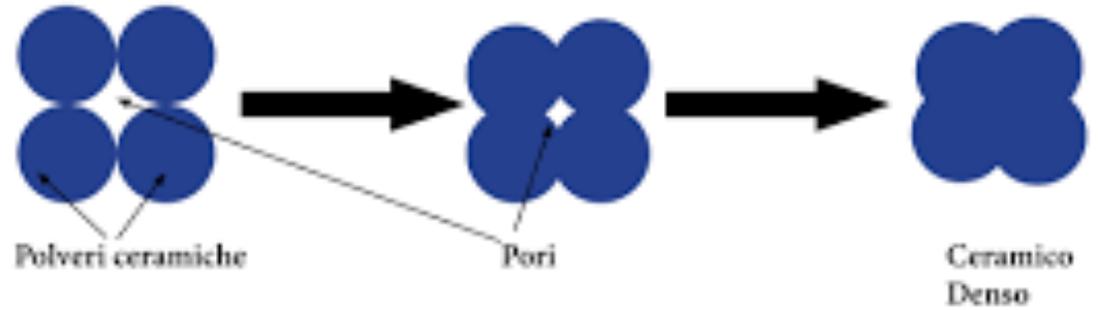
SINTERIZZAZIONE $Ce_{0.9}Gd_{0.1}O_2$

Fluorite (GDC-GADOLINIA DOPED CERIA):

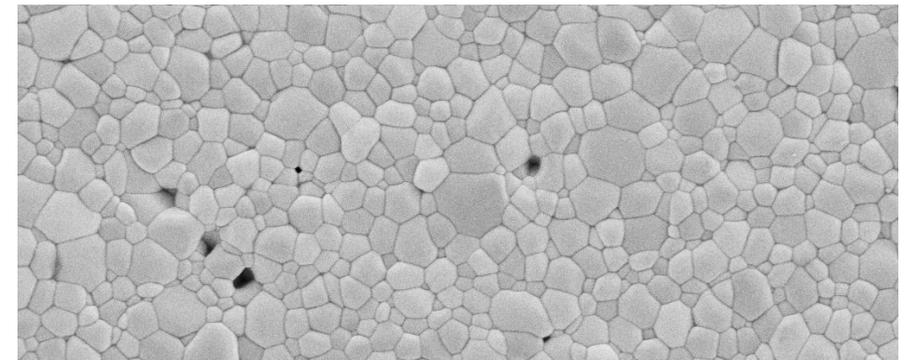
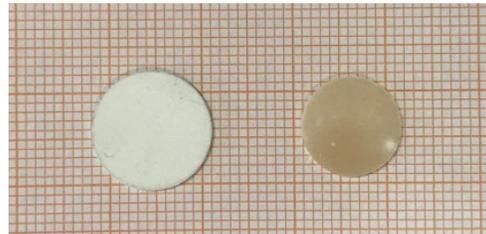
Misto polvere di GDC e PVP

Densità → buona conducibilità ionica

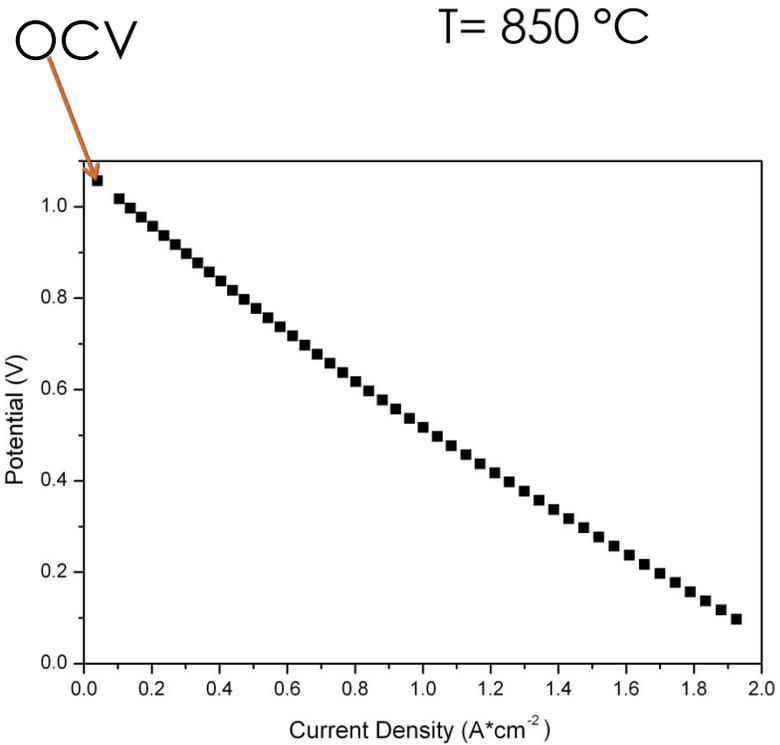
Pressatura della polvere



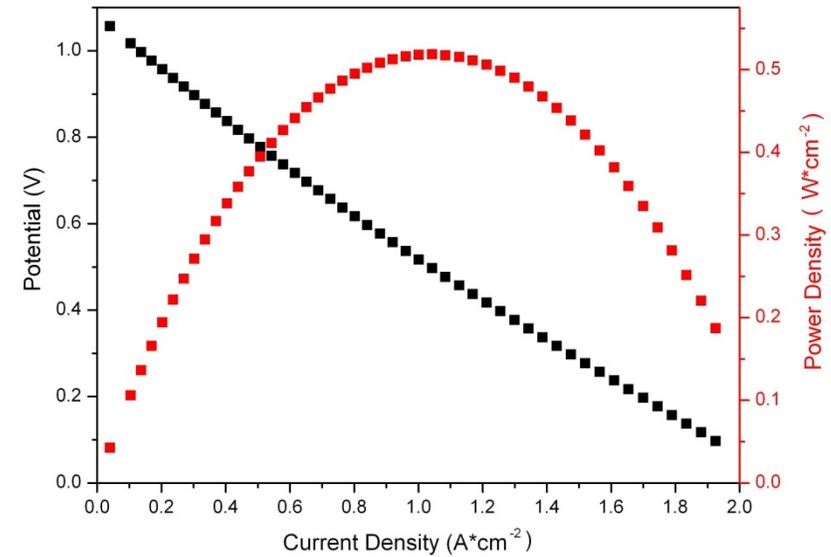
Sinterizzazione (1500°C per 10 h)



SOFC: test della cella



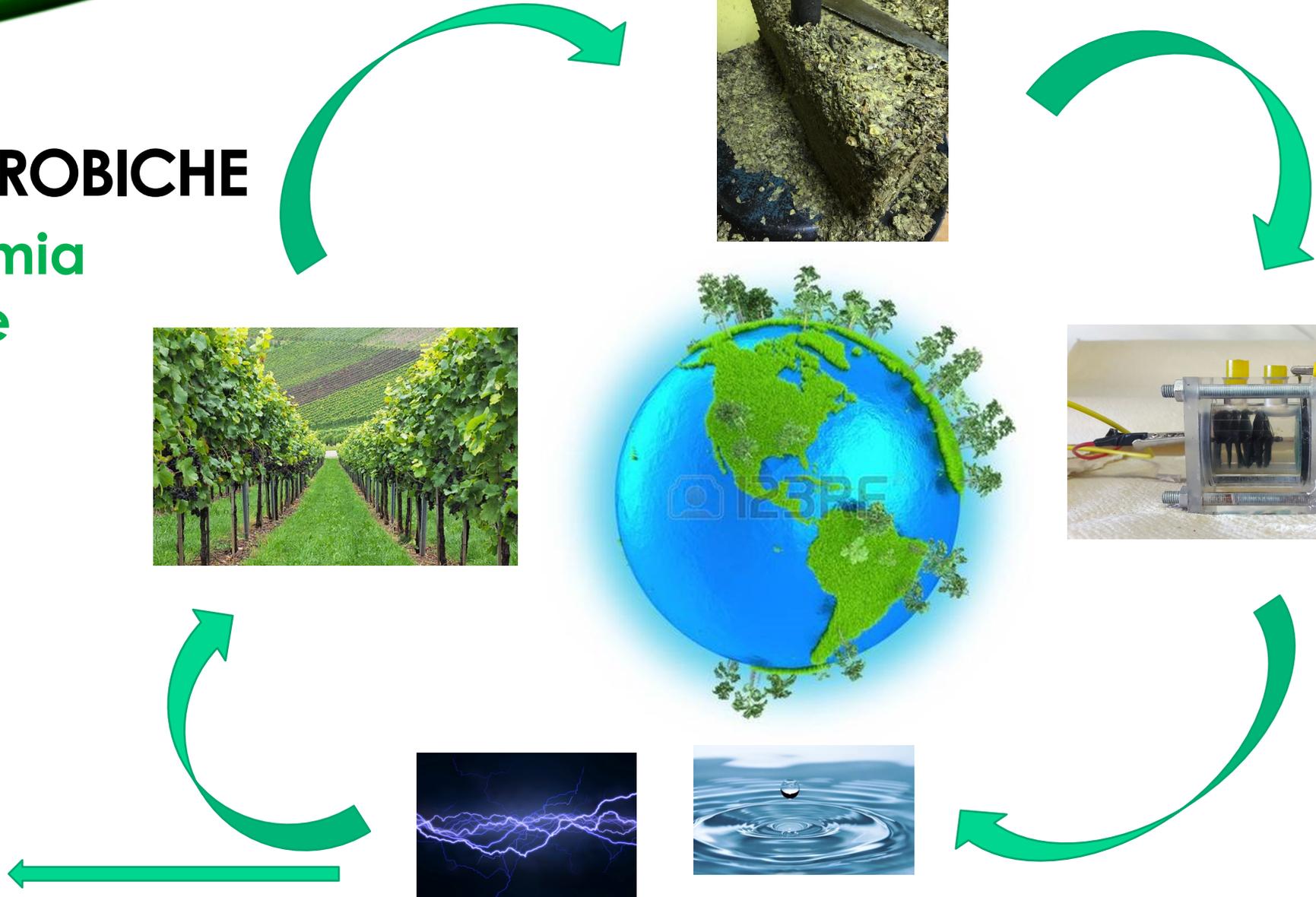
Corrente e tensione della cella



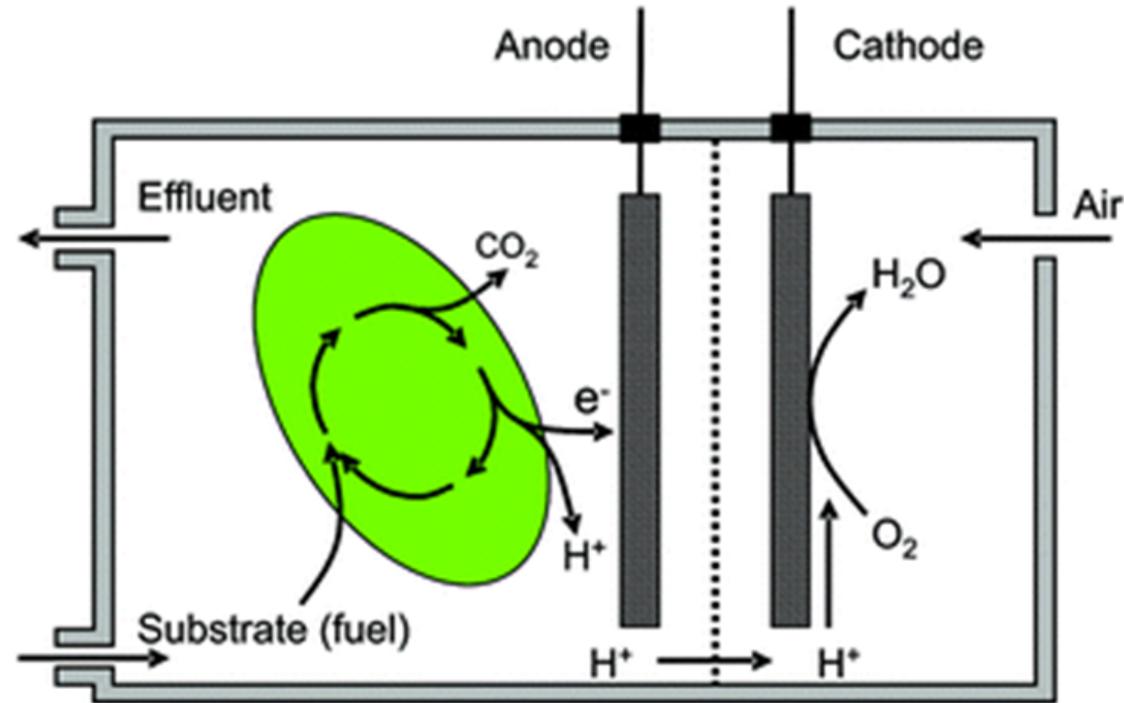
Potenza della cella



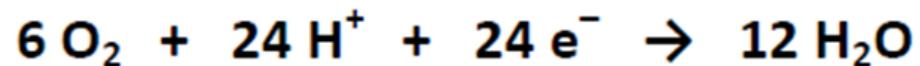
LE CELLE MICROBICHE nell'economia circolare



FUNZIONAMENTO MFC



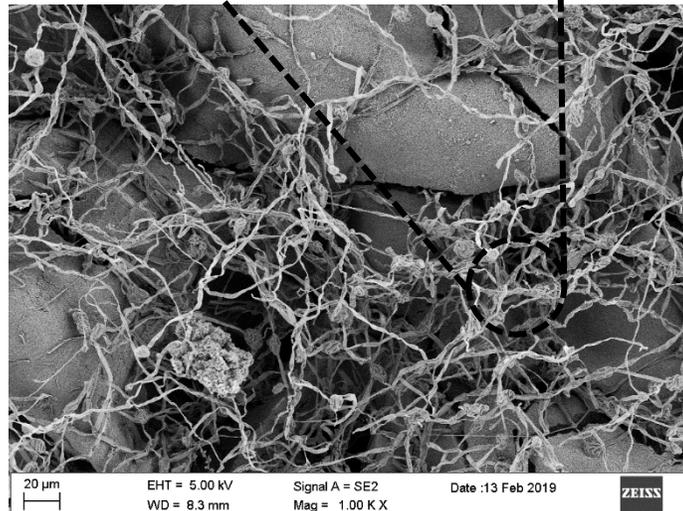
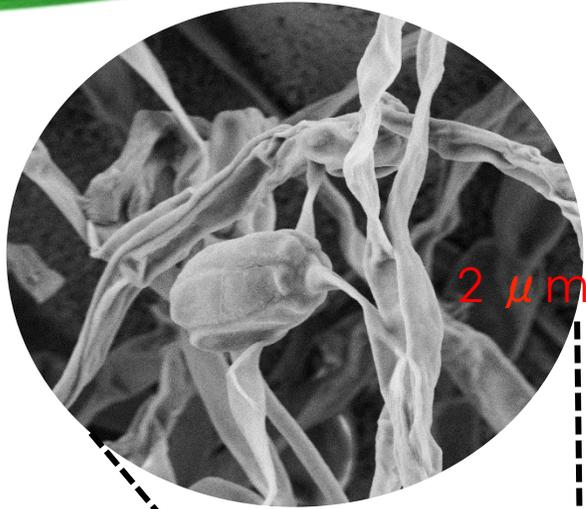
Anodo, ossidazione



Catodo, riduzione



ASSEMBLAGGIO DELLA MFC



ANODO



CATODO



Condizioni di operazione

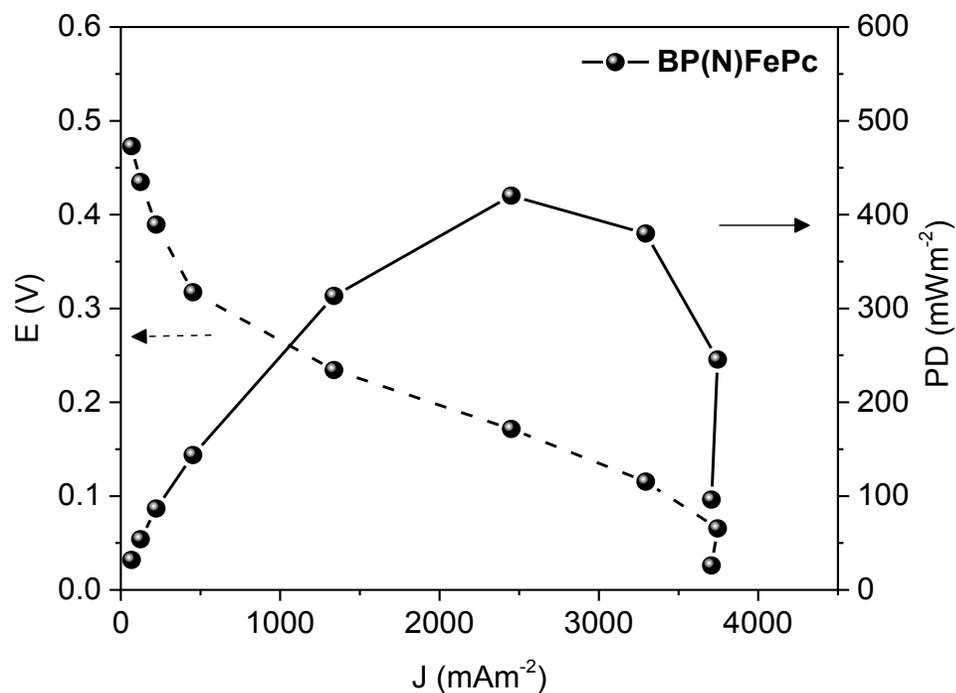
- Tampone fosfato pH neutro
- 1 mgL^{-1} acetato di sodio
- E (V) registrati ogni 15 minuti
- Cicli di voltaggio registrati a $1 \text{ K}\Omega$
- Temperatura = $23 \pm 2^\circ\text{C}$

Densità di corrente

$$J \text{ (mA}\cdot\text{m}^{-2}) = E \text{ (V)} / R \text{ (\Omega)} * A \text{ (cm}^2)$$

Densità di potenza

$$PD \text{ (mW)} = J \text{ (mA}\cdot\text{m}^{-2}) * E \text{ (V)}$$

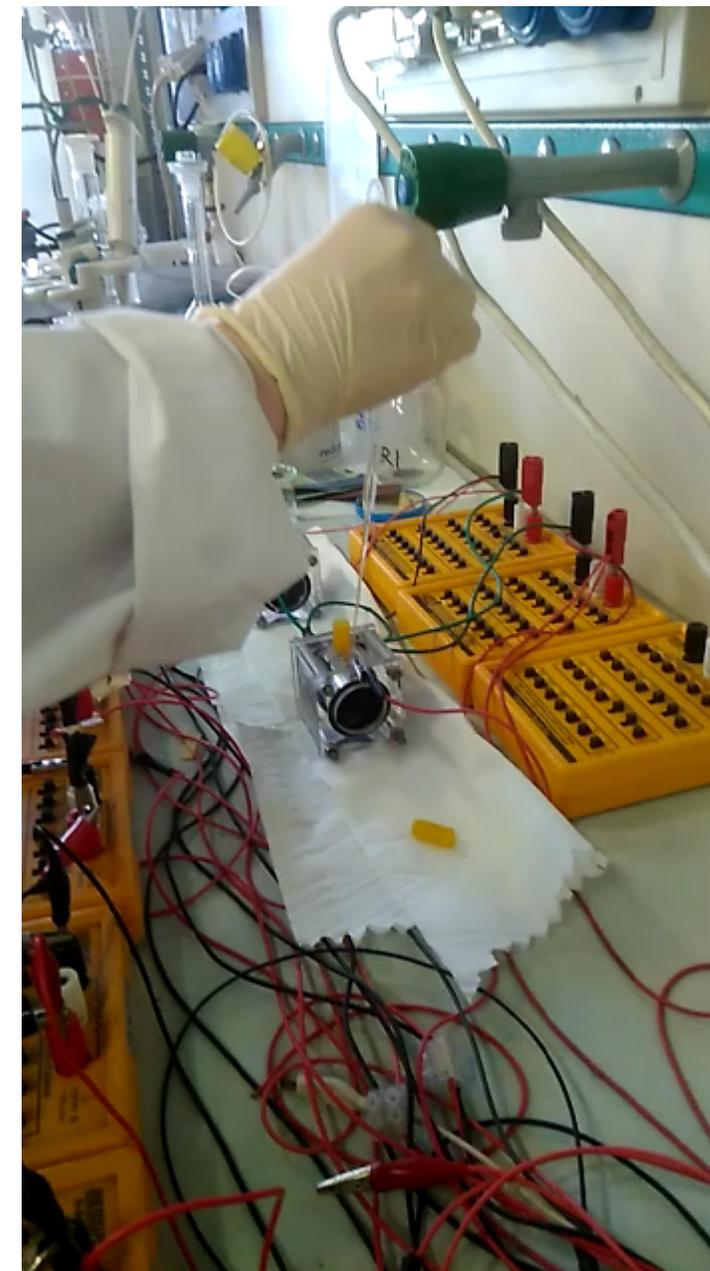


$$PD_{max} = 420.9 \text{ mW}\cdot\text{m}^{-2}$$

$$J = 2446.3 \text{ mA}\cdot\text{m}^{-2}$$

$$E = 0.2 \text{ V}$$

$$J = 1958.3 \text{ mA}\cdot\text{m}^{-2}$$



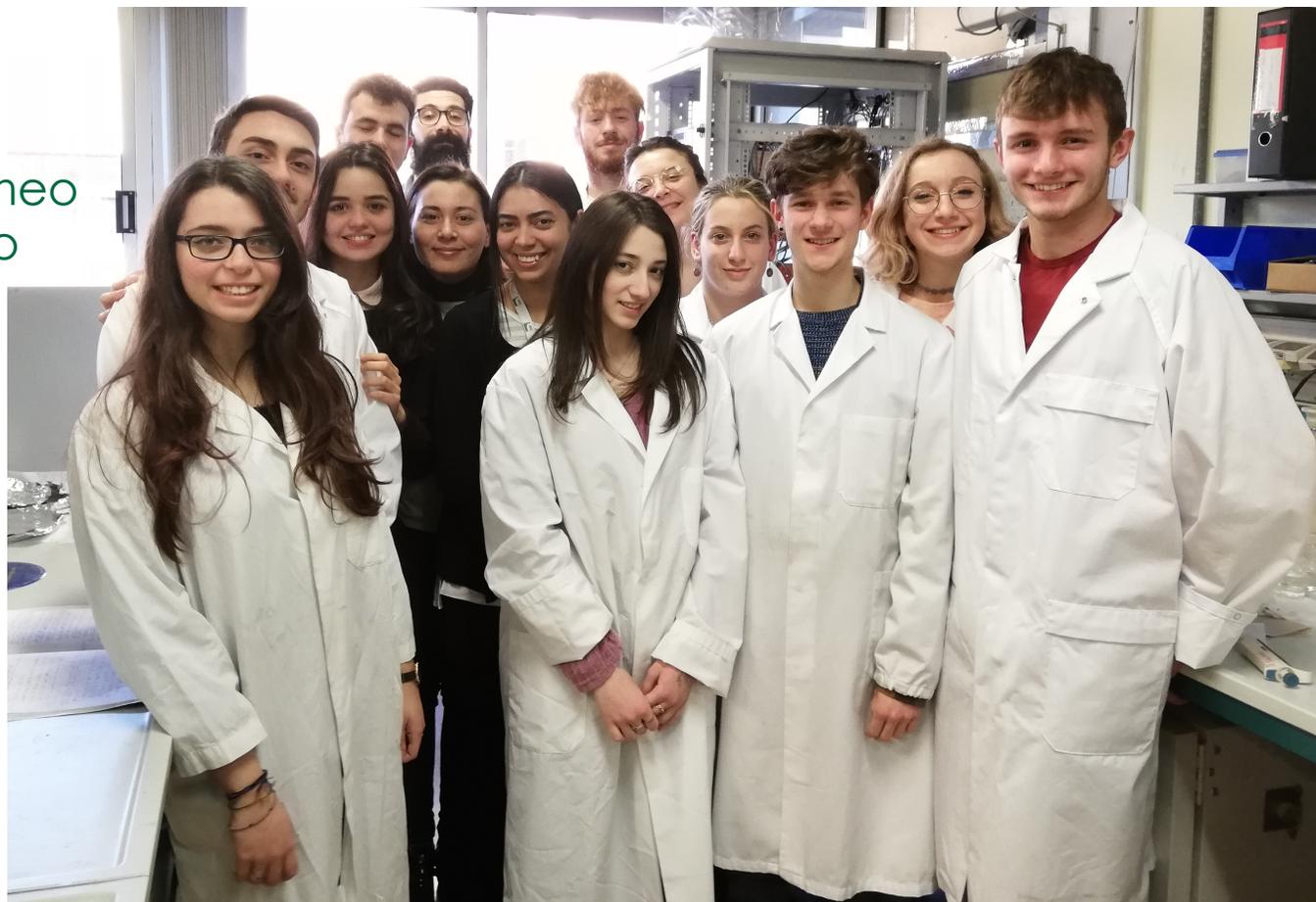
GRAZIE PER L'ATTENZIONE

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Leonardo Duranti
Valerio Ficca



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Rioli Gioia
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Tecchio Emanuele