

# Developing alkaline water electrolyzers for **green hydrogen** production

*Desenvolvimento de eletrolisadores alcalinos para a  
produção de **hidrogénio verde***

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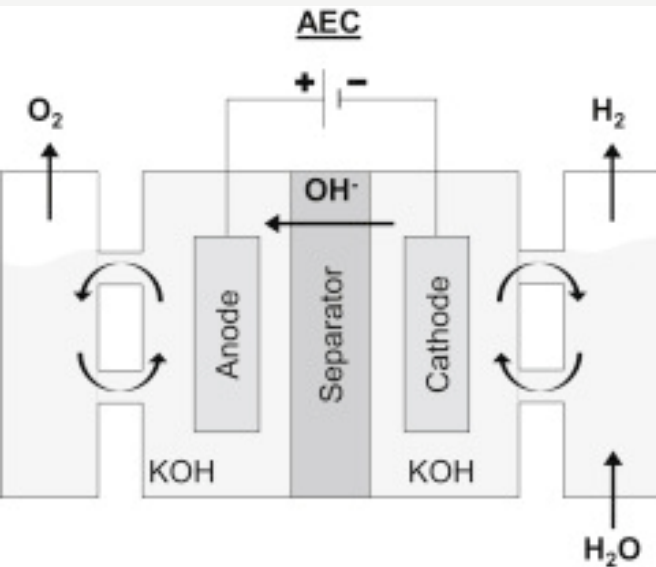
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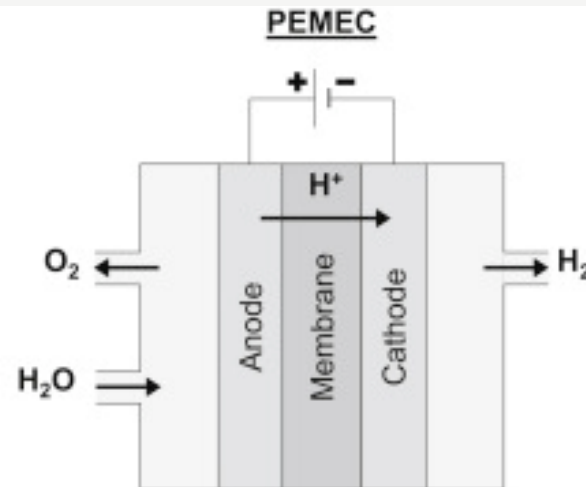
## Water electrolysis



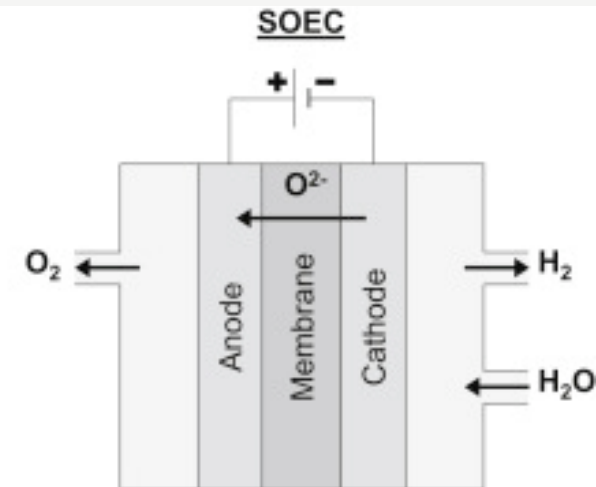
### Alkaline



### PEM



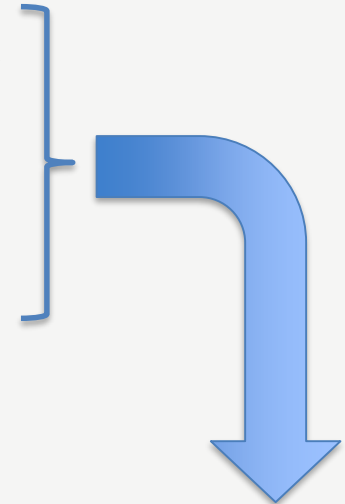
### Solid oxide



## Enhance alkaline water electrolysis

### Requirements for alkaline water electrolyzers

- ✓ Lowering overpotential for both HER and OER
- ✓ Maintaining stability of the electrodes' activity
- ✓ Lowering electrolysis process price

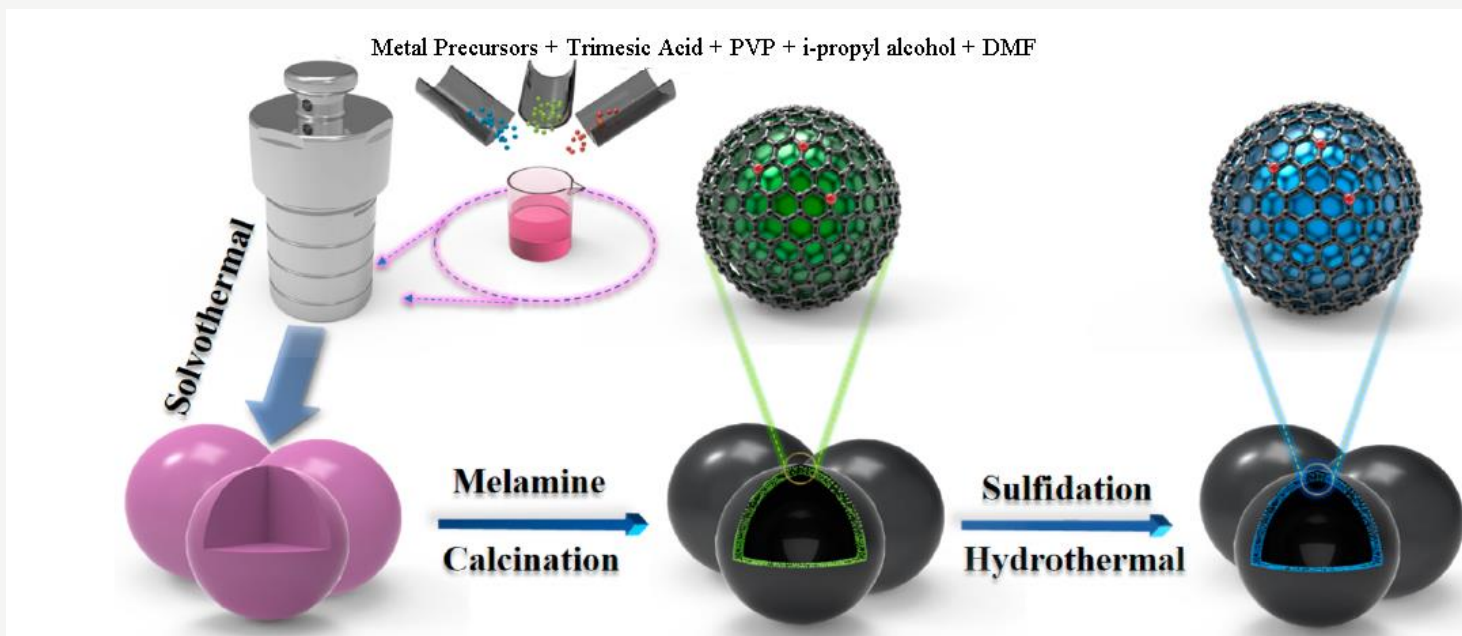


- **developing efficient electrode materials (high activity and stability)**
- **improving the properties of the electrolyte solution**

## Developing higher activity catalysts

New type of electrocatalysts based on the **ideal 3D structure of heteroatom incorporated multishelled nanostructured hollow spheres**

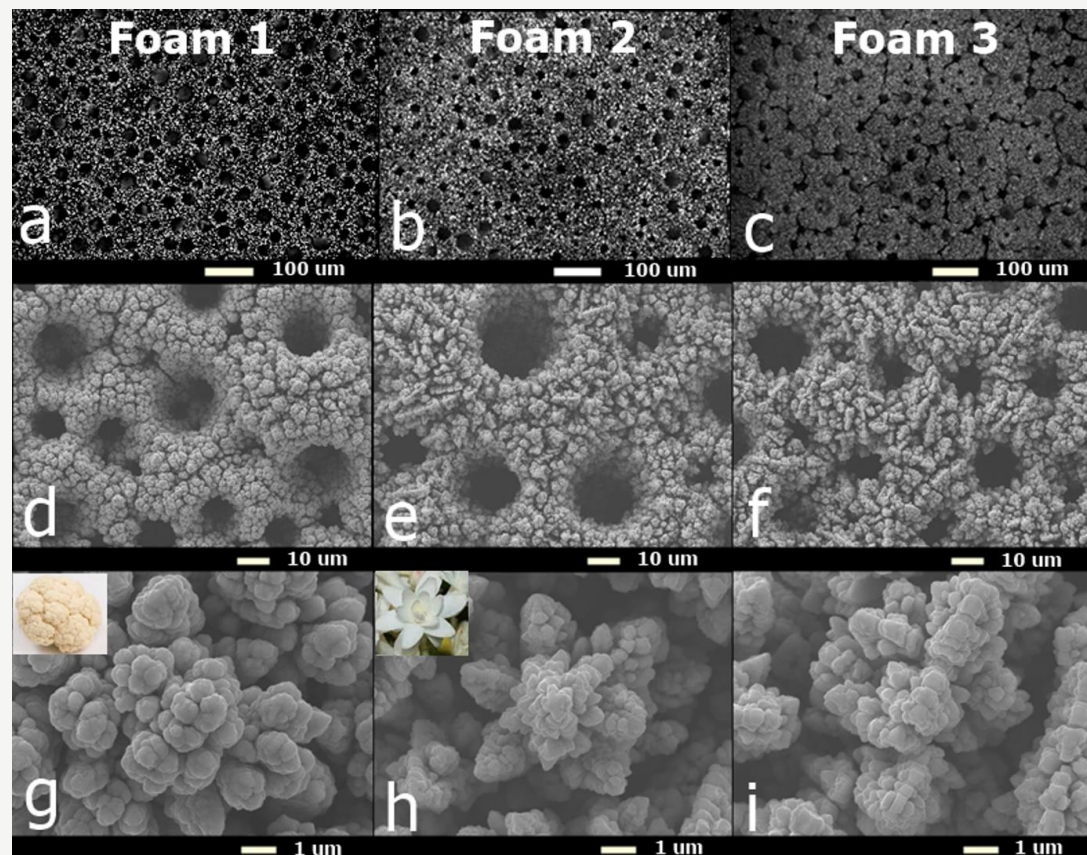
- The shell number, shell spacing, and exterior shell structure will be **correlated with their electrocatalytic performance** for HER and OER
- **DFT analyses will accelerate the screening of possible compositions** for the nanomaterials synthesis



## Developing low-cost and stable catalysts

### Production of Ni-based electrodes using the dynamic hydrogen bubble template (DHBT)

- **Simple and low-cost route avoids the need for binders** that contribute to increased electrode resistivity
- **3D porous architecture** leads to increased activity and longer lifetime
- **Low weight and 3D open morphology** allow fabricating lighter electrodes with increased surface area

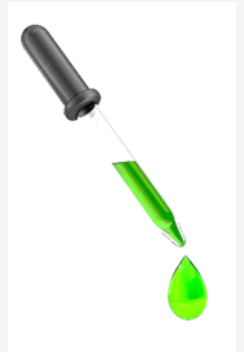


*K.I. Siwek, S. Eugénio, D.M.F. Santos, M.T. Silva, and M.F. Montemor, Int. J. Hydrogen Energy 44 (2019) 1701*

## Improving the electrolyte solution

**Tuning the composition** of the electrolyte solution by including **additives**

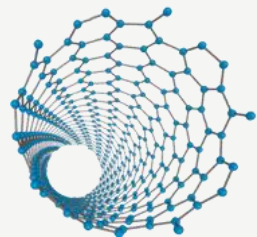
**Modification of the electrolyte composition** by adding small amounts of **magnetic ionic liquids** to the electrolyte solution



- The fluids adsorption at the electrodes' surface **changes the interfacial properties**
- **Interaction with the formed  $H_2/O_2$  bubbles**, promotes their release and decreasing the electrolyte resistance, thereby **reducing electrical costs**

Thus, the magnetic ILs should be able to promote the bubbles release **by the action of an external magnetic field**

*Submitted FCT project (CeFEMA, CQE, FCT-NOVA)*



**CeFEMA**

Center of Physics and  
Engineering of Advanced  
Materials

**CeFEMA** and **FCT** for a contract in the scope  
of programmatic funding UIDP/04540/2020...

...AND **TH**<sub>2</sub>ANK YOU  
FOR YOUR ATTENTION!

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