Chiral photoelectrodes for efficient generation of hydrogen through photoelectrocatalytic water-splitting

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Introduction

- **Photoelectrocatalytic water-splitting** is a process which mimics the natural photosynthesis by producing hydrogen using solar energy in the presence of a photoelectrocatalyst.
- **Why hydrogen? I**t is renewable, non-toxic, by products of combustion are not harmful to humans and has high energy density
- **Challenges of photoelectrocatalytic water-splitting** High Oxygen Evolution Barrier, high overpotential and formation of hydrogen peroxide which affects the stability of the photoelectrodes.

Results

- Water splitting experiments have been carried out using: bare electrodes and electrodes coated with chiral and achiral molecules.
- Quantification of hydrogen peroxide by spectrophotometric titration of the electrolytes was carried out.
- Electrolyte obtained from bare photoelectrodes and photoelectrodes coated with achiral molecules showed the presence of hydrogen peroxide by peaking at 436nm.
- For the electrolyte that had chiral molecule coated photoelectrodes, no detectable amount of hydrogen peroxide was observed. The results are as shown if figure 2 below:

Hypothesis

The high overpotential and peroxide formation associated with the artificial process may be reduced by using chiral based electrodes.

Experimental

The functionalised photoelectrodes are fabricated by prepared coating the electrodes with chiral molecules. To assess performance of the electrodes, water splitting tests are carried out in which chiral molecule coated photoelectrodes, achiral molecule coated photoelectrodes and bare electrodes are used and their performance compared.

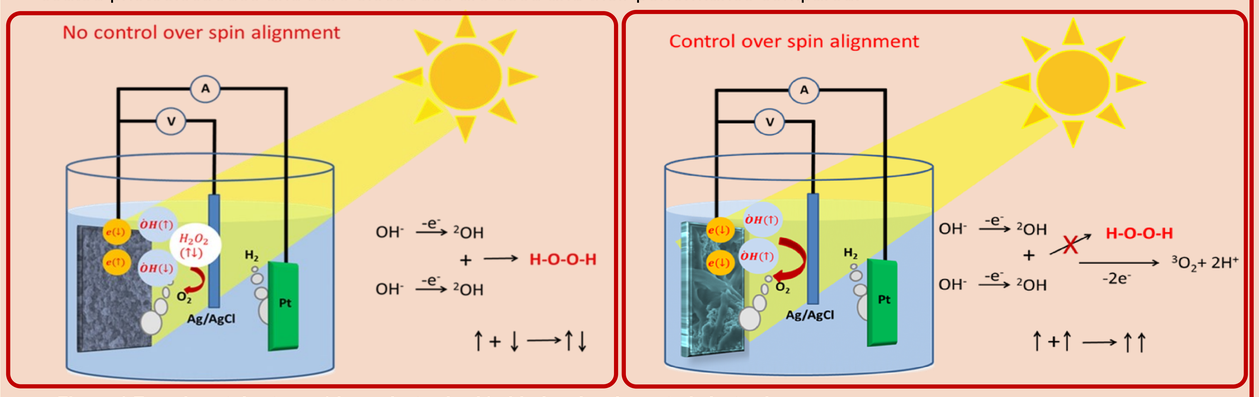
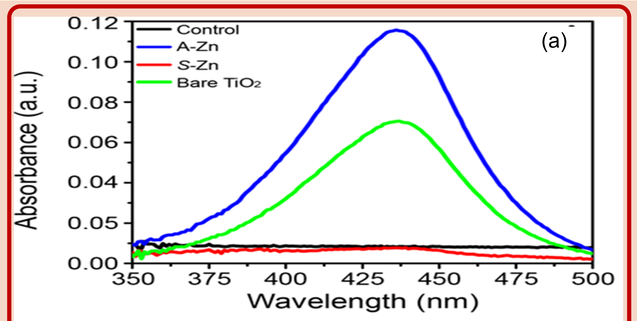
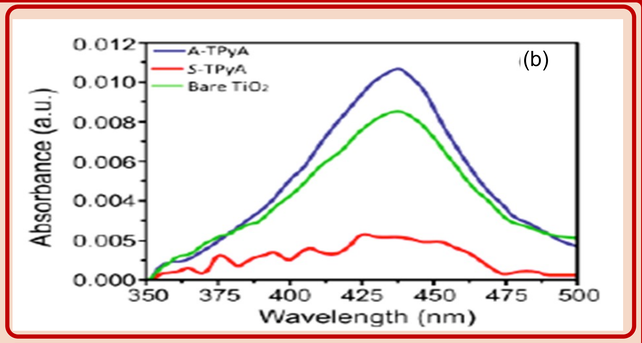


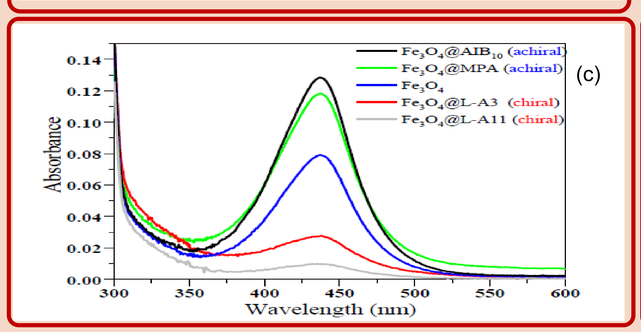
Figure 1 Experimental set up a) bare electrodes b) chiral molecule coated electrodes

With no spin control, H_2O_2 formation is favoured on the singlet surface

By using chiral-molecule coated electrodes spin control of electrons is introduced







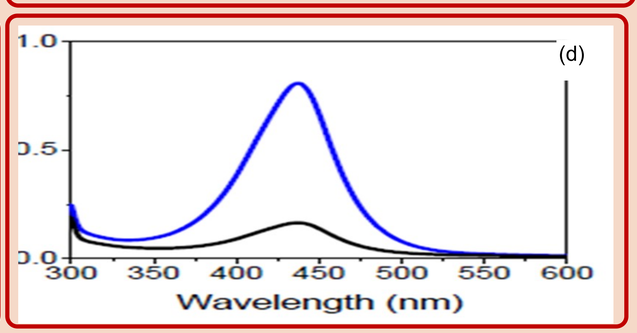


Figure 2: (a) Comparison of H_2O_2 from PECs using Bare TiO_2, achiral Zn porphyrins and chiral Zn porphyrins molecules (b) Comparison of H_2O_2 present from PECs using bare TiO_2, achiral molecule and chiral molecules (c) Comparison of H_2O_2 present in a PEC using bare Fe_3O_4 NPs, Fe_3O_4 NPs coated in achiral molecules and Fe_3O_4 NPs coated in chiral molecules (d) Comparison of H_2O_2 from PECs using L-CoOx (chiral) and meso-CoOx (achiral)

Conclusion

This research highlights the importance of spin on water splitting and how it improves the efficiency of the PEC

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