UNIVERSITAT JAUME·I

Lab session 3: Water spliting

Objective:
Produce hydrogen by photo and electro-catalysis of water.

Materials

Nanoporous TiO_2 Films
water
salt
Platinized FTO Glass / Pt electrodes
UV Lamp
2 multimeters
Power supply
Glass
Support elements
Crocodile/banana banana/banana wires

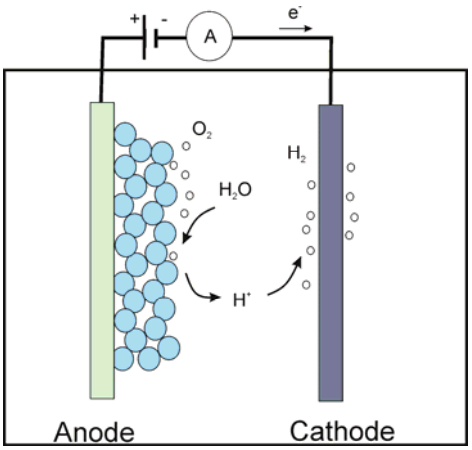

Figure 1: experimental configuration

Procedure:
- Experimental assembly
Immerse the TiO_2 (anode) and platinized (cathode) electrodes in into a 0.1 M salt solution in water. Avoid direct contact between conducting parts and between contacts and water. Connect the TiO_2 electrode with the platinized one through the multimeter in microampere configuration.

- WS characterization
Measure the current crossing the multimeter without shinning UV-light. Switch on the UV light (365 nm position) and measure the difference in current with respect to the "dark" conditions This is the photocurrent produced by photocatalysis. Repeat this process for the different samples you have.

Take the sample with the greater photocurrent and insert the power supply in the circuit as indicated in Fig. 1.
In the dark, apply voltage until obtaining a current of several mA (~ 2.0-2.5 V) and observe bubbles formation in the electrodes. Here we produce oxygen and hydrogen by catalytic electrolysis. Take current and voltage at each 200 mV. Invert the polarity of the power supply and repeat the experiment. In this configuration the reactions will change of electrode. Note that with this polarization in which the TiO_2 is the cathode, it may change in colour due to H^+ insertion. With the data obtained build a graph of the current-Voltage (*I-V*) curve in the dark.
Repeat the experiment under illumination and represent the *I-V* curve in the same graph as the dark curve

Results
Provide I-V curves and estimate H_2 production from current data assuming 100% electron to hydrogen transfer efficiency for the different samples.

References: [1-2]
1. Gimenez, S.; Dunn, H. K.; Rodenas, P.; Fabregat-Santiago, F.; Miralles, S. G.; Barea, E. M.; Trevisan, R.; Guerrero, A.; Bisquert, J. Carrier density and interfacial kinetics of

mesoporous TiO2 in aqueous electrolyte determined by impedance spectroscopy. *Journal of Electroanalytical Chemistry* **2012,** *668*, 119-125.

2. Walter, M. G.; Warren, E. L.; McKone, J. R.; Boettcher, S. W.; Mi, Q.; Santori, E. A.; Lewis, N. S. Solar Water Splitting Cells. *Chemistry Reviews* **2010,** *10*, 6446–6473.