Toward Tandem Solar Cells for Water Splitting using polymer electrolytes

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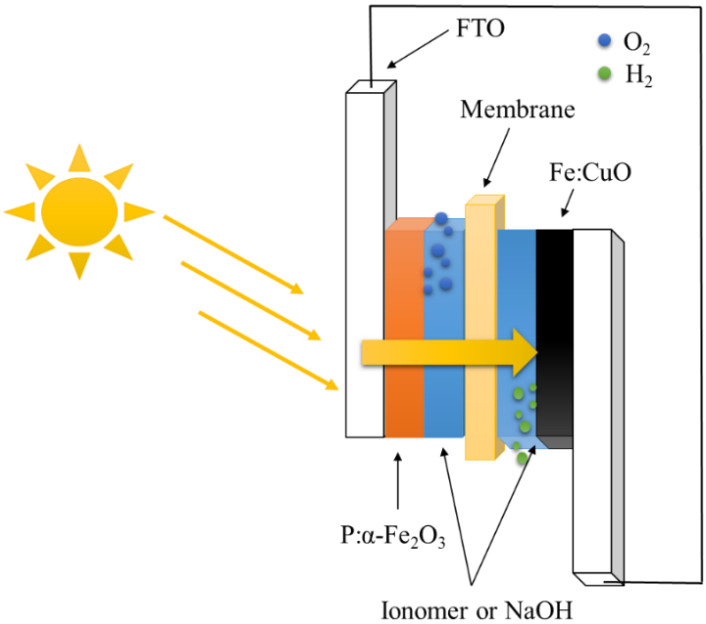
The increasing global energy demand and the emission of pollutant gasses to the atmosphere due to the use of fossil fuels require further research in environmentally friendly alternatives. In this respect, photoelectrochemical water splitting may play an important role in the future for producing hydrogen as a carbon-free fuel. Tandem cells formed by two photoelectrodes with complementary light absorption are postulated as key for obtaining hydrogen in a clean and inexpensive way. [1,3]

In this context, this communication focuses on the photoelectrochemical (PEC) performance of a tandem cell based on a P:α-Fe_2O_3 photoanode and a Fe:CuO photocathode for water photosplitting, with the employment of a polymeric membrane electrolyte. The structure, morphology, and oxidation states of the electrodes are analyzed by means of XRD, SEM, TEM and XPS. Different configurations have been studied, including those employing exclusively polymer ionomer and those comprising a 0.1M KOH solution in either one or both electrode compartments. For the sake of comparison, photoelectrochemical cells formed by one of the photoelectrodes and one dark electrode have also been under scope.



Scheme 1. Scheme of a tandem cell for overall water splitting comprising a P:Fe_2O_3 photoanode and a Fe:CuO photocathode.

The employment of a polymer membrane instead of the typical acidic or basic aqueous electrolytes is expected to diminish the corrosion of the electrodes and thus to increase the stability of the device.

The PEC measurements were performed using a complete tandem cell configuration, as shown in Scheme 1. The current-voltage curves illustrate the concept and point to the viability of this approach. In particular, an open circuit voltage of 0.25V (see inset Fig. 1) is attained.

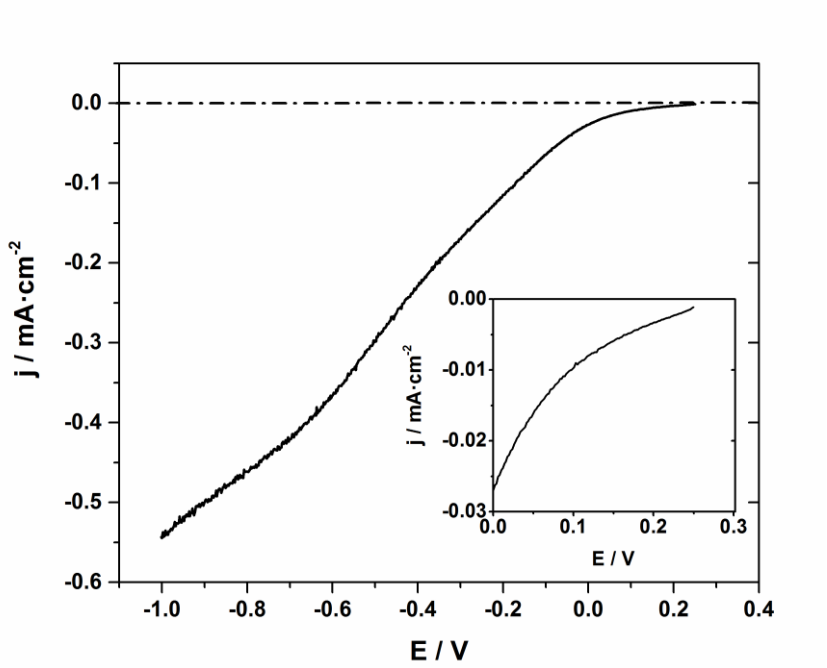


Figure 1. Current-voltage curves for a tandem cell formed by a P:Fe_2O_3 photoanode and a Fe:CuO photocathode (black curve). Both an alkaline membrane and 0.1M KOH were employed as electrolytes. The curve was recorded under normalized illumination of 100mW·cm^{-2}. The P:Fe_2O_3 photoanode side of the cell was exposed to the incident light. The inset shows the detail of voltammetric curve.

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