

ÉVORA  
September 2-4

## An electrochemical process for the production of synthetic fuels at low temperatures

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Following work exploring the low temperature electrolysis in alkaline media, using graphite consumable anodes, from which syngas was obtained<sup>1</sup>, laboratory studies have been conducted in acid media pursuing higher efficiency in the production of hydrogen and synthetic fuels. Experiments were conducted in an own designed undivided planar cell with 25 cm<sup>2</sup> geometrical area electrodes using a 0.5 M H<sub>2</sub>SO<sub>4</sub> solution with and without Fe(II) additions. Fe<sup>2+</sup> oxidizes to Fe<sup>3+</sup> at the anode surface. The redox couple Fe<sup>3+</sup>/Fe<sup>2+</sup> acts as an oxidation mediator not only oxidizing the bulk and detached graphite but also the surface functional groups. The practical experimental potential for graphite oxidation is within the range for the electrooxidation of the Fe redox couple giving as a result a 4-fold increase in the amount of produced CO<sub>2</sub> at near room temperature, when using 0.025 M FeSO<sub>4</sub>.

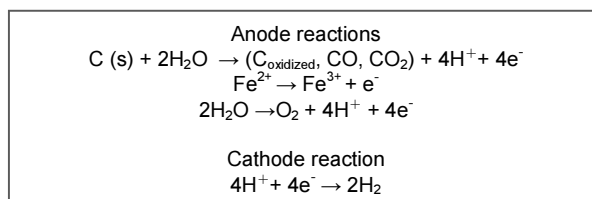
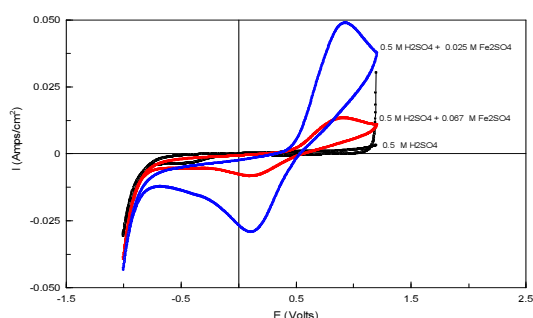


Fig. 1- Cyclic voltammogram for graphite electrodes in 0.5 M H<sub>2</sub>SO<sub>4</sub> solutions with and without FeSO<sub>4</sub> additions (a), Simplified reactions (b).

The voltammetric experiments were carried out with a wave form generator from PARC, model 273, controlled by a PC (software "Corrware") using a Greene cell with a three electrode configuration and were instrumental to establish operational conditions for the electrolysis cell. Gaseous product analysis was carried out using a Micro GC 300 gas chromatograph from Agilent.

The electrochemical oxidation of graphite proceeds at near room temperature in the presence of Fe ions with the production of pure gases (21% CO<sub>2</sub>, 3% CO and ~70% H<sub>2</sub>). Produced oxygen is thought to be totally consumed. Traces of CH<sub>4</sub> and C<sub>2</sub>H<sub>6</sub> were also detected.

### Acknowledgements



Project SYM\_QREN 38940

### References

1. J. Rodrigues, Portuguese Patent 106779 T: Obtenção de gás de síntese por eletrólise alcalina da água, 2013.02.13