ELECTROCHEMICAL MICROREACTORS FOR THE SYNTHESIS OF CHEMICALS AND THE ABATEMENT OF ORGANIC POLLUTTANTS

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ABSTRACT

Electrochemical methods can offer new sustainable routes for both the synthesis of chemicals and the abatement of organic pollutants resistant to biological processes. These methods use a clean reagent, the electron, and very mild operative conditions (ambient temperature and atmospheric pressure) with limited operative costs. However, electrochemical processes present some important disadvantages when performed in conventional reactors. In particular, to achieve reasonable cell voltages when the medium has not an adequate conductivity, one needs adding to the system a supporting electrolyte. This is certainly a main obstacle for a wide application of electrochemical tools. Indeed, adding chemicals is often a problematic issue, since this may lead to the formation of secondary products, makes more difficult the separation procedures and increases the operative costs. Recently it has been shown that the electrochemical processes can strongly benefit from the utilization of microfluidic electrochemical reactors (i.e. cells with a distance between the cathode and the anode of tens or hundreds of micrometers) allowing to minimize or even remove some of the above mentioned disadvantages. Thus, very small distances between electrodes lead from one side to a drastic reduction of the ohmic resistances (allowing to operate with lower cell voltages and without supporting electrolyte) and on the other side to intensify the mass transport of the reagents towards electrodes surfaces. The utilization of micro devices may present the drawback of a more easy fouling but also other potential advantages such as an easier scale-up procedure through simple parallelization of many small units. Furthermore, since a very high conversion for passage can be achieved, the process can be performed under a continuous mode thus allowing a fast screening of the effect of operative parameters due to very short times of treatment. It would be also possible to operate with a series of micro cells with different applied current densities thus increasing both the current efficiency and the productivity of the cell [1-5].

In the present work some electrochemical processes for the synthesis of fine chemicals and the abatement of pollutants were studied in microfluidic cells and in a stack with multiple cells in series with the aim of evaluating the advantages given by the utilization of microfluidic reactors.

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