Electrochemical Characterization of the Microband Graphite Electrodes

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Abstract

The microband design (Fig. 1A) of microelectrodes is a cost-effective and easily-fabricated compromise combining convergent mass transport, due to microscale width as a critical dimension, and high output currents due to the macroscopic length. Among the various techniques available for microband electrode fabrication, screen-printing stands out as an inexpensive approach. The application of cross cutting to deliver micro-scale thickness overcomes the problem of the insufficient resolution of screen-printing in lateral dimensions (approx. 0.05 mm).

Numerical simulations utilizing the finite element method with a modified diffusion domain approach and periodic boundary conditions developed for microband arrays were used for modeling the voltammetric response of the developed microband electrodes. In order to describe the voltammetric response of the microband array, a single electrolyte domain (Fig. 1B) bound to a single graphite microelectrode and the surrounding in- plane insulator were chosen.

Voltammetric responses of the ferrocenedimetanol redox probe were studied on the graphite screen printed electrodes (Fig. 1C). The graphite microband arrays showed pronounced sigmoidal voltammetric responses, typical for micro-scale electrodes with enhanced mass transport of the redox material to/from the electrode, due to convergent diffusion.

Figures used in the abstract

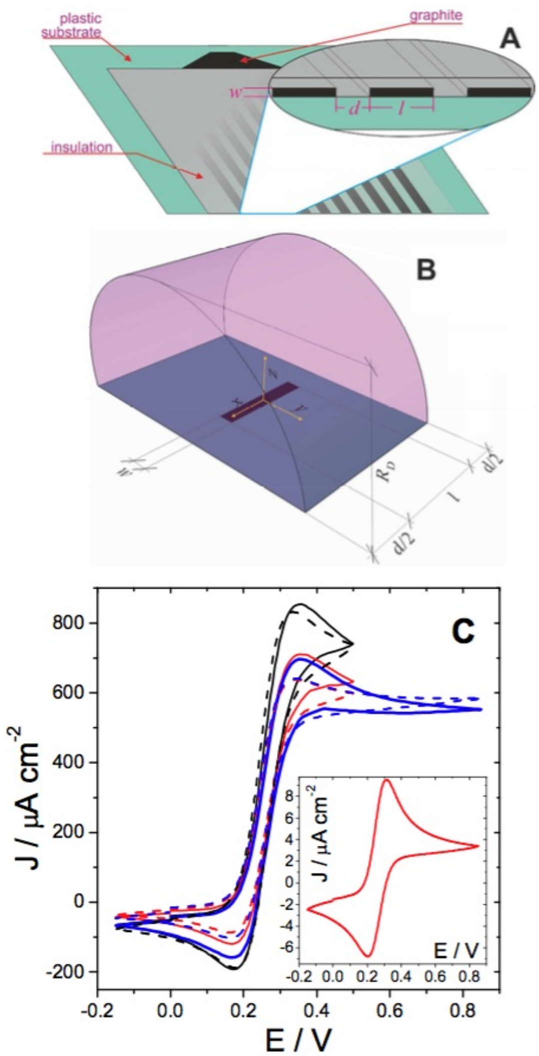

Figure 1: Figure 1. Microband electrode characterization. A: the layout of the screen-printed graphite microband electrode arrays; B: simulation domain at a single microband electrode; C: experimental and simulated voltammetric responses (solid and dashed curves respectively) of ferrocenedimethanol at the graphite microband electrode; Inset: voltammetric response at the graphite disk electrode (0.1 M HCl, 1 mM FcDM, scan rates: 50 mV/s (red and blue curves) and 200 mV/s (black curve).

Figure 2

Figure 3

Figure 4