Diffusion-Controlled Redox Cycling at Nanoscale Interdigitated Electrodes

A Computational study with femlab

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ABSTRACT

Computational simulation of diffusion controlled redox cycling behavior at nanoscale interdigitated electrodes (IDEs) was performed. Cyclic voltammograms were obtained for IDEs with various sizes and spacing. The current collection efficiency and redox cycling number as a function of the electrode dimensions were measured. We found that as the size of the IDEs decreases from a microscale to a nanoscale, the shape of the voltammogram changes from a peak-shaped curve to a sigmoidal curve without any hysteresis. The collection efficiency reached almost 100% with nanoscale IDEs, suggesting that the highly efficient redox cycling activity prevents the escape of the redox species into the bulk solution. This study provides new insight into how to achieve steady-state response with extremely high redox cycling number and collection efficiency with nanoscale IDEs for the development of highly sensitive and rapid responding biosensors.