Rapid Voltammetric Measurements at Conducting Polymer Microelectrodes Using Ultralow-Capacitance Poly(3,4-ethylenedioxythiophene):Tosylate

We use a vapor-phase synthesis to generate conducting polymer films with low apparent capacitance and high conductance enabling rapid electrochemical measurements. Specifically, oxidative chemical vapor deposition was used to create thin films of poly(3,4-ethylenedioxythiophene):tosylate (PEDOT:tosylate). These films had a conductance of 17.1 ± 1.7 S/cm. Furthermore, they had an apparent capacitance of 197 ± 14 μF/cm², which is an order of magnitude lower than current commercially available and previously reported PEDOT. Using a multistage photolithography process, these films were patterned into PEDOT:tOsylate microelectrodes and were used to perform fast-scan cyclic voltammetry (FSCV) measurements. Using a scan rate of 100 V/s, we measured ferrocene carboxylic acid and dopamine by FSCV. In contrast to carbon-fiber microelectrodes, the reduction peak showed higher sensitivity when compared to the oxidation peak. The adsorption characteristics of dopamine at the polymer electrode were fit to a Langmuir isotherm. The low apparent capacitance and the microlithographic processes for electrode design make PEDOT:tosylate an attractive material for future applications as an implantable biosensor for FSCV measurements. Additionally, the integration of PEDOT:tosylate electrodes on plastic substrates enables new electrochemical measurements at this polymer using FSCV.

General information
Publication status: Published
Organisations: Department of Micro- and Nanotechnology, Nanoprobes, Polymer Micro & Nano Engineering, University of Arizona
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Number of pages: 10
Pages: 8009-8018
Publication date: 2016
Peer-reviewed: Yes

Publication information
Journal: Langmuir
Volume: 32
Issue number: 32
ISSN (Print): 0743-7463
Ratings:
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.99 SJR 1.559 SNIP 1.178
Web of Science (2016): Impact factor 3.833
Web of Science (2016): Indexed yes
Original language: English
DOI:
10.1021/acs.langmuir.6b01423
Source: FindIt
Source ID: 2307036001
Research output: Contribution to journal › Journal article – Annual report year: 2016 › Research › peer-review