

Characterization of PEDOT used as ion-to-electron transducer with eQCM

Polyxeni Damala, Eric Bakker

Department of Inorganic and Analytical Chemistry, University of Geneva,
Quai Ernest-Ansermet 30, CH-1211 Geneva, Switzerland
polyxeni.damala@unige.ch

Conducting polymers have been studied with great interest over the last decades as they may offer unique ion-to-electron transduction properties and help to improve electrochemical performance of electrochemical sensors. Some of the most common materials used in the field of electrochemistry include poly(3-octylthiophene) (POT), polypyrrole (PPy), poly(aniline) (PANI) and poly(3,4-ethylenedioxythiophene) (PEDOT). Although the choice of the polymer is a compromise of many aspects, the use of certain PEDOT derivatives can be advantageous in view of the reported drawbacks manifested by other polymers such as POT, which is known to be light sensitive.¹ PEDOT is prepared via electrochemical polymerization from a solution of the monomer and a supporting electrolyte. The resulting polymer is positively charged and incorporates doping ions from the electrolyte, which act as charge compensators.² As of today, several studies have examined the influence of the supporting electrolyte on the electrochemical and mechanical properties of the resulting film.^{3,4} As evidenced,⁵ the structure of the film and the level of water uptake can significantly influence the potential stability of sensors based on the non-hydrophobic form of PEDOT. Its hydrophobic derivatives, including PEDOT-C₁₄, have not been studied to such an extent. The enhanced hydrophobicity of PEDOT-C₁₄ makes it particularly suitable for use as an ion-to-electrode transducer in potentiometry.⁶

In the present study, we examine how different supporting electrolytes with doping ions of varying size and properties (e.g. lipophilicity), change the physicochemical properties of the film during the electropolymerization of certain EDOT derivatives. Using eQCM we monitor changes of the polymer structure (mass growth, viscoelasticity) and electrochemical behavior (capacitance, ion-exchange properties). By comparing different PEDOT materials used as ion-to-electrode transducers, we show how the shift to a hydrophobic derivative could help us adjust and predict their electrochemical behavior with greater accuracy. This knowledge is valuable for building stable potentiometric sensors as well as novel voltammetric sensors with desired charge- and ion-transfer properties.

- [1] T. Lindfors, *J. Solid State Electr.* **2009**, 13, 77–89.
- [2] C. Calberg, X. Chen, O. Inganäs, *Solid State Ionics* **1996**, 85, 73–78.
- [3] V.-T. Gruia, A. Ispas, I. Efimov, A. Bund, *J. Solid State Electr.* **2020**, 24, 3231–3244.
- [4] K. Cysewska (nee Włodarczyk), J. Karczewski, P. Jasinski, *Electrochim. Acta* **2015**, 176, 156–161.
- [5] V. Krikstolaityte, R. Ding, T. Ruzgas, S. Björklund, G. Lisak, *Anal. Chim. Acta* **2020**, 1128, 19–30.
- [6] M. Guzinski, J. M. Jarvis, P. D’Orazio, A. Izadyar, B. D. Pendley, E. Lindner, *Anal. Chem.* **2017**, 89, 8468–8475.