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Formation of polypyrrole with dexamethasone as a dopant: its cation and anion exchange properties

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Abstract

There is considerable interest in dexamethasone, a synthetic glucocorticosteroid drug, and a number of reports detailing the controlled release of dexamethasone from polypyrrole have been published. However, polypyrrole-doped with dexamethasone is poorly characterised. In this study, polypyrrole doped with dexamethasone was formed at relatively low applied potentials of 0.70 V or 0.80 V vs SCE by carrying out the electropolymerisation on an initial pre-layer of polypyrrole. These polymers displayed electroactive behaviour with a dexamethasone doping level of 0.30 ± 0.03 and using impedance measurements the charge-transfer resistance was computed as 400 Ω . Mixed ion transport was observed. In addition to the release of dexamethasone, hydrated sodium cations were incorporated to maintain charge neutrality on reduction of the polymer. Approximately 200 $\mu\text{g cm}^{-2}$ of dexamethasone was released following 60 min on reduction of the polymer at -0.90 V vs SCE. It was possible to re-use the polymer to release the drug by repeated oxidation and reduction steps, where dexamethasone was incorporated during oxidation and released on reduction. During these events, sodium was accumulated within the polymer matrix and this high salt content accompanied with swelling and de-swelling events gave rise to the development of cracks in the polymer matrix.

Key words: polypyrrole; dexamethasone; electropolymerisation; sodium accumulation; mixed ion exchange.

1. Introduction

In recent years there has been considerable interest in conducting polymers as they possess a range of interesting properties and potential applications. Furthermore, they are easily formed and fabricated using electropolymerisation with a suitable dopant or by chemical

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