Evaluation of the potential dependence of 2D-3D growth rates and structures of polypyrrole films in aqueous solutions of hexafluorates.

Autorzy

Marcin Chmielewski

Maria Grzeszczuk

Jerzy Kalenik

Anna Kępas-Suwara

Rok wydania

2010

Czasopismo

Journal of Electroanalytical Chemistry

Numer woluminu

647

Strony

169-180

DOI

10.1016/j.jelechem.2010.06.006

Kolekcja

Naukowa

Język

Angielski

Typ publikacji

Artykuł

Streszczenie

Polypyrrole hexafluorosilicate, $PPYSiF_6$, and polypyrrole hexafluoroaluminate, $PPYAlF_6$, were found to follow the mixed 2DI–3DI kinetic model of electrodeposition in the potentials range (+0.80 V, +0.60 V) and (+0.95 V, +0.55 V) *vs.* SCE, respectively. The potentiostatic depositions of polypyrrole were performed on polycrystalline gold and on the single layer or bilayer polypyrrole films. Only in the case of the third layer deposition of $PPYSiF_6$ (on $PPYSiF_6$) at +0.6 V, the experimental current was found to fit better with the 2DP–3DI model. For electrodeposition of $PPYAlF_6$ on gold, a slightly better quality fitting with 2DP–3DP or 2DP–3DI kinetic models was observed only for some samples synthesized at 0.55 V. In general, contribution of the 2D structure in the polypyrrole deposits was observed to decrease with an increase of the polarization potential. Conclusions of the mathematical analysis of the current–time functions are in accordance with a texture of the outer surface of the polymer layers visible in SEM micrographs. The apparent rate constants of the lateral and outward growths of polypyrrole increase with potentials in (+0.55, +0.80) V range. Under assumption of the classical electrochemical kinetics law, the anodic transfer coefficients were found lower than 0.5. Values of the outward growth rate constant were of the order of 10^{-8}–10^{-10} mol/(s cm^2); being approximately one order of magnitude higher for polypyrrole hexafluorosilicate than for polypyrrole hexafluoroaluminate. The lateral growth rates of $PPYAlF_6$ on gold were found to depend on the electrodeposition potential more significantly than the outward growth rate. An increase in the growth rates with the potential was observed to diminish/vanish at E > +0.80 V, probably due to concurrent degradation processes of polypyrrole chains. The analysis of the deposition currents was done under conditions of the masking double layer currents that were characterized by the relaxation times of the order of seconds or longer.

Słowa kluczowe

Potentiostatic deposition, Nucleation and growth, Kinetic parameters, 2D and 3D structures, Layer-by-layer deposition, polypyrrole, Hexafluoroanions of Al(III) and Si(IV)