Electrophoretic Deposition Behavior of Chitosan Biopolymer as a Function of Solvent Type

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Graphical abstract

The influence of three different solvents including lactic acid, formic acid, and acetic acid on the constant-voltage electrodeposition behavior of chitosan biopolymer was investigated. In this regard, charge density, viscosity, and some molecular parameters of chitosan solutions in aqueous acids were studied. The mechanism of chitosan film formation was investigated by fitting the current density–time experimental data to the Pierce and Miskovic film growth models. It was found that solvents have a significant influence on the molecular structure and electrodeposition behavior of chitosan. Using formic acid as the solvent caused the best electrophoretic mobility and resulted in a less porous film compared to acetic acid and lactic acid.

Keywords Biopolymers; Chitosan; Electrophoretic deposition; Film growth model

INTRODUCTION

Chitosan, a polysaccharide formed primarily of repeating units of α-(1→4)-2-amino-2-deoxy-D-glucose (or D-glucosamine). Most of the properties of chitosan can be related to its cationic nature, which is unique among plentiful polysaccharides and natural polymers¹. Due to their unique properties including biodegradability, biocompatibility, nontoxicity, and biofunctionality, chitin- and chitosan-based materials have been examined increasingly over the last decade. Using these materials, a number of potential products have been developed for areas such as pharmaceuticals, biomedicine, agriculture, food industry, cosmetic, waste water treatment (removal of heavy metal ions), dyes, and biotechnology²,³.

Electrodeposited chitosan, which is responsive to localized electrical signals, serves as an excellent candidate for biomedical devices such as biomicro electromechanical systems (bio MEMS), biosensors and biochips⁴, as well as composites based on bioactive glass⁵, hydroxyapatite (HA)⁶, bioactive glass–HA⁷, HA–carbon nanotubes⁸, and HA–CaSiO₃⁹. Simchi et al.¹⁰ studied the electrophoretic mobility of chitosan in aqueous solutions as a function of pH. Aider et al.¹¹ have also shown that the electro migration of chitosan