LITERATURE REVIEW ON ELECTRODEPOSITION AS THE NEW METHOD FOR THE MODIFICATION OF FIBROUS BIOMATERIALS

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[ENGINEERING OF BIOMATERIALS 138 (2016) 102]

Introduction

The mechanism of electrophoretic deposition comprises deposition of charged particles on the electrode chemicals under the influence of an applied electric field. Theoretical foundations of this process were developed in the nineteenth century, when the Russian scientist Ruess watched the movement of clay particles in the water under the influence of an applied voltage. With the first practical application of this phenomenon we have to deal with in the 40s of the twentieth century (deposition of thorium particles to platinum cathode) and also then firsts patent occurred, while the largest development in this field appeared to be in the 80s and 90s. To date, electrodeposition has found wide use in the preparation of coatings of various types, e.g. strengthening wear resistance, antioxidant, functional coatings for advanced microelectronic devices and solid oxide fuel cells, as well as for the preparation of bioactive coatings and composite materials.

Recently, there is a big increase in interest in the technique especially in industrial applications due to its high versatility (as regards to the choice of base materials and the coating materials), the simplicity of the entire process, low cost of equipment and its maintenance. Among the other advantages we can mention among others short time of deposition, small constraints on the shape of the substrate (carrier to deposit layers) and the fact that, compared to other advanced techniques for deposition, the EPD process can be easily modified for a particular application. For example, deposition can be performed on flat surfaces, cylindrical or any other and this will require only minor changes in the design of electrodes and their positioning [1]. Furthermore, despite the fact that the EPD is a wet process, it ensures control over the thickness and to some extent the morphology of the coating formed by adjusting the deposition time and the applied potential.

The kinetics of electordeposition and characteristics of the produced layers depend on two groups of parameters - associated with the solution for deposition (which consists of the following factors: the particle size and the concentration [2,3], the dielectric constant, [4] conductivity of the solution and the viscosity [5,6], the zeta potential [7-10] and related to the process - physical parameters such as the type of electrodes or the process conditions (e.g. the applied voltage [11,12], the time of deposition [13,14], etc. Unfortunately, the knowledge in shaping the properties of the coatings obtained and the kinetics of the process is not well-structured and there is a lack of systematic scientific description of these issues.

A reasonable is also to conclude that electrodeposition of various types of coatings on metal substrates is relatively well established technique compared to the use EPD for surface modification of fibrous biomaterials, the structure and properties of which (mechanical, thermal, electrical etc.) are significantly different from those mentioned hereinabove. A major limitation in the case of fibrous materials is that most of them have poor conductivity, which often precludes the use of electrophoretic deposition. In contrast, a number of advantages of various types of fibrous structures (e.g. porous structure, flexibility, possibility for obtaining composite structures etc.) caused a significant increase of interest in these carriers and methods of their potential modifications [15].

The work aims at presenting the theoretical review of the current state of the art in the area of the electrodeposition of ultra-thin polymer layers on fibrous structures.

Acknowledgments

The project “Electrodeposition of ultra-thin polymer layers as the novel method of modification of fibrous biomaterials” was accepted in June 2016 and declared for financing by National Science Centre in Poland (2015/19/N/ST8/02456).

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