Hybrid Materials Based on Polymers and Porous Clay Heterostructures

PhD Thesis Abstract

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The main purpose of this Phd thesis, **Hybrid materials based on polymers and porous clay heterostructures** is to add an important original contribution in the field of polymer-clay hybrid materials, with properties that make these materials suitable for biomedical field (drug delivery systems). The original contributions of this research study are: *(1) the synthesis of some new inorganic materials- porous clay heterostructures (PCHs), (2) the investigation of PCHs as hosts for the encapsulation of active substances and (3) the synthesis of hybrid materials based on polymers and PCHs.* (1) In this context new PCHs types were synthesized and characterized using as co-surfactant two types of polyether monoamines (Surfonamine B100 and Surfonamine B200) and also the optimum parameters of PCHs synthesis were established. The synthesis strategy of porous clay heterostructures (PCHs) and the study of optimum reaction parameters lead to the development of some new inorganic materials with different structures, tunable textural properties and porous structures with various shapes and sizes. (2) Furthermore PCHs were investigated regarding their encapsulation capacity of antitumoral active substances (5-Fluorouracil – 5FU and Methotrexate - MTX). This research proposes to establish the optimal parameters for encapsulation of the active substances (5-FU and MTX) in PCHs. In this regard, following an extensive research study the optimal parameters for encapsulation of 5-FU in PCHs were identified. All results confirmed that the optimal parameters for encapsulating 5-FU in PCHs are: 20 °C, 30 minutes, using a reaction medium with a pH value of 11, and in the case of MTX encapsulation in PCHs, the results of UV-VIS analysis demonstrate that PCHs have a significantly higher MTX encapsulation efficiency than montmorillonite (MMT- starting clay in the PCHs synthesis). All characterization results showed that PCHs can be used as hosts for encapsulating active substances, thus making valuable original contributions to the field of drug delivery systems. (3) Another originality element demonstrated in this Phd thesis is the use of PCHs in the synthesis of hybrid materials based on polymers and clay (PCHs). Following the experimental study, it was shown that the introduction of PCHs into a polymer matrix has a strong influence on the hybrid materials properties. The thermogravimetric analysis (TGA) results showed that the presence of PCHs in the polymer matrix improves the thermal stability of the hybrid film, which is attributed to the barrier effect induced by the presence of PCHs in the polymer matrix. At the same time, polymer-PCHs hybrid materials have been proposed for the first time in the literature as hosts for encapsulating antitumor active substances (5-Fluorouracil). The results of the UV-VIS analysis demonstrated that the encapsulation efficiency of 5-FU in the hybrid material is strongly influenced by the presence of PCHs in the system. Thus, the samples that contain PCHs show an encapsulation efficiency clearly superior to the neat polymer matrix (alginate). The presence of PCHs in the polymer matrix can adjust the 5-FU drug release profile and also it can reduce burst release effect present in case of neat polymer matrix.

Keywords: hybrid materials, polymer, clay, porous clay heterostructures, active substances