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CHITOSAN SELF-ASSEMBLED THIN-FILM: INFLUENCE OF SOLUTION CONCENTRATION ON THE FILM ROUGHNESS AND THICKNESS

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ABSTRACT
The self-assembly technique was used to deposit chitosan on chemically functionalized glass slides. The concentration of the chitosan solution used in the self-assembly process was varied and the morphologies of the films were investigated by atomic force microscopy. The thickness of chitosan films attained a constant value (20nm) for polymer concentration higher than 20g/L but the film roughness increased linearly in the range 10-50g/L. Such a behavior may be attributed to the occurrence of aggregation on the more concentrated chitosan solutions.
KEYWORDS: chitosan; self-assembled films; atomic force microscopy.

EXPERIMENTAL
A commercial chitosan (Fluka/Biochemika, from crab shells) was previously purified as described elsewhere[(1)] and then used in the self-assembly process as aqueous solutions of variable concentration. An aqueous solution of acetic acid (pH≅3.0) was used as the solvent and the chitosan concentration was varied in the range 3-50g/L. The glass slides (5mm x 10mm x 2mm) were previously functionalized as described elsewhere[(2)] and stocked in dessecator. The films were deposited on the glass slide by direct immersing it into the chitosan solution for three minutes followed by rinsing with deoinized water. The films were allowed to dry spontaneously and three substrates were separately dipped and examined to assure the reproducibility of the results. The AFM images were acquired in non-contact mode and the analyses were performed by a TOPOSPM software.

RESULTS
The SA technique has been recently used for preparing chitosan ultra-thin films[(3)] aiming to study its potential utilization as active sensor media and also as edible coatings to preserve fruits and vegetables[(4)]. The films of chitosan prepared in the present work, independently of the polymer concentration used in the film deposition, were heterogeneous structures characterized as irregular surfaces containing “mountain-and-valley” features (Figure 1A). These films seem to be formed by clusters of chitosan chains of regular dimensions, which were more easily observed the higher the polymer concentration used in the deposition process.

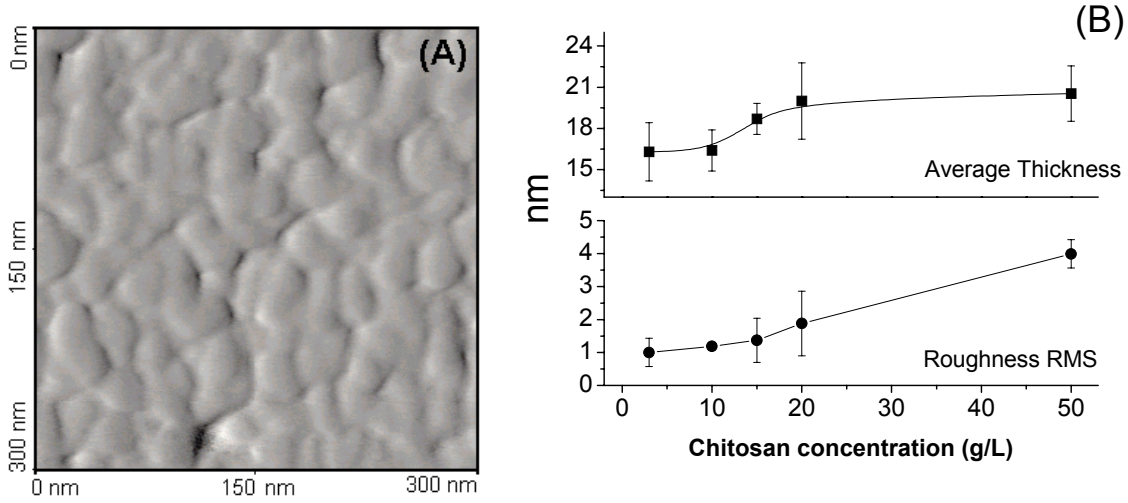

Figure 1. (A) Chitosan film formed by using a 10g/L chitosan solution in the self-assembly process. (B) Final film thickness and roughness as a function of the chitosan concentration.

As the chitosan concentration used for the film formation was increased, the film thickness increased from 13nm to 22nm, stabilizing at this latter value for polymer concentration higher than 20g/L, however, the film roughness increased linearly with increasing polymer concentration (Figure 1B). It is suggested that the occurrence of a concentration-dependent aggregation process in the chitosan solution, mainly in the more concentrated ones, resulted in the deposition of chitosan clusters that strongly affected the film roughness.

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