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Layer-by-layer films of latex, natural gum and carboxymethyl-chitosan

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Abstract: Ultra-thin films of natural rubber latex, chicha and carboxymethyl-chitosan were fabricated using the layer-by-layer (LbL) technique, which may be used in sensing and biosensing. Different supramolecular architectures were tested, including tri-layers, at a fixed pH value, with some indication of distinct intermolecular interactions due to the order of deposition of the materials. The roughness of the as-formed mixed LbL films was analyzed by atomic force microscopy.

Natural rubber latex (NRL), carboxymethyl-chitosan (CMC) and natural gums are easily found in nature, some of them being biocompatible, with all having high potential of application[1-3]. To illustrate, chitosan and natural gums are exploited in biosensors[4], and NRL was successfully applied in the regeneration of ocular conjunctiva of rabbits[1]. The use of ultra-thin films, such as those made using the layer-by-layer technique (LbL), allows the fabrication of distinct supramolecular structures, which represent a functional tool in several applications[5,6]. In this work we describe mixed LbL films of NRL, natural gum (chicha) and CMC, envisaging future functionalities for sensors.

LbL tri-layer films containing NRL, chicha and CMC were fabricated keeping an immersion time of 5 minutes and pH 10 in all solutions. Different supramolecular architectures were tested, as illustrated in Figure 1, and distinct behaviours were observed when NRL is on them bottom or at the top of the LbL films. It seems that NRL governs aggregation and affects strongly the molecular interactions between the film and the substrate[7]. A linear growth was observed in most cases as the same amount of material was transferred at each deposition step. Some LbL films were also tested at pH 8, for which NRL hampers the tri-layer film formation. The values of the root mean square (rms) roughness for the LbL films obtained from atomic force microscopy (AFM) images are presented in Table 1. LbL films containing CMC presented lower rms values probably due to better intermolecular interactions in the LbL structures.

Table 1: AFM rms roughness values for the LbL films.

Film	Rms values (nm)
NRL	0.80
Chicha + NRL	3.16
CMC + NRL	0.67
Chicha + NRL + CMC	0.46

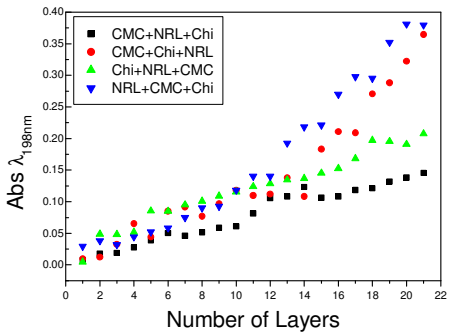

Figure 1: Tri-layers at pH 10 at different supramolecular architectures.

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