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Monitoring Surface Modification of Polylactide Nonwoven Fabric with Weak Polyelectrolytes

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Abstract : In this study, great attempts have been made to initially modify polylactide (PLA) nonwoven surface with poly(amidoamine) (PAMMA) dendritic polymer to create amine active sites on PLA surface through aminolysis reaction. Further, layer-by-layer deposition of four layers of two weak polyelectrolytes, including PAMAM as polycation and polyacrylic acid (PAA) as polyanion on activated PLA, was monitored with turbidity analysis of waste-polyelectrolytes after each deposition step. The FTIR-ATR analysis confirmed the successful introduction of amine groups into PLA polymeric chains through the emerging peak around 1650 cm^{-1} corresponding to N-H bending vibration and a double wide peak at around 3670-3170 cm^{-1} corresponding to N-H stretching vibration. The adsorption-desorption behavior of (PAMAM) and poly (PAA) deposition was monitored by turbidity test. Turbidity results showed the desorption and removal of the previously deposited layer (second and third layers) upon the desorption of the next layers (third and fourth layers). Also, the importance of proper rinsing after aminolysis of PLA nonwoven fabric was revealed by turbidity test. Regarding the sample with insufficient rinsing process, higher desorption and removal of ungrafted PAMAM from aminolyzed-PLA surface into PAA solution was detected upon the deposition of the first PAA layer. This phenomenon can be due to electrostatic attraction between polycation (PAMAM) and polyanion (PAA). Moreover, the successful layer deposition through LBL was confirmed by the staining test of acid red 1 through spectrophotometry analysis. According to the results, layered PLA with four layers with PAMAM as the top layer showed higher dye absorption (46.7%) than neat (1.2%) and aminolyzed PLA (21.7%). In conclusion, the complicated adsorption-desorption behavior of dendritic polycation and linear polyanion systems was observed. Although desorption and removal of previously adsorbed layers occurred upon the deposition of the next layer, the remaining polyelectrolyte on the substrate is sufficient for the adsorption of the next polyelectrolyte through electrostatic attraction between oppositely charged polyelectrolytes. Also, an increase in dye adsorption confirmed more introduction of PAMAM onto PLA surface through LBL.

Keywords : surface modification, layer-by-layer technique, weak polyelectrolytes, adsorption-desorption behavior
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