

Layer-By-Layer Deposition of Poly (Amidoamine) and Poly (Acrylic Acid) on Grafted-Polylactide Nonwoven with Different Surface Charge

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Abstract : In this study, poly (amidoamine) dendritic material (PAMAM) and poly (acrylic acid) (PAA) as polycation and polyanion were deposited on surface charged polylactide (PLA) nonwoven to study the relationship of dye absorption capacity of layered-PLA with the number of deposited layers. To produce negatively charged-PLA, acrylic acid (AA) was grafted on the PLA surface (PLA-g-AA) through a chemical redox reaction with the strong oxidizing agent. Spectroscopy analysis, water contact measurement, and FTIR-ATR analysis confirm the successful grafting of AA on the PLA surface through the chemical redox reaction method. In detail, an increase in dye absorption percentage by 19% and immediate absorption of water droplets ensured hydrophilicity of PLA-g-AA surface; and the presence of new carbonyl bond at 1530 cm^{-1} and a wide peak of hydroxyl between $3680\text{-}3130\text{ cm}^{-1}$ confirm AA grafting. In addition, PLA as linear polyester can undergo aminolysis, which is the cleavage of ester bonds and replacement with amid bonds when exposed to an aminolysis agent. Therefore, to produce positively charged PLA, PAMAM as amine-terminated dendritic material was introduced to PLA molecular chains at different conditions; (1) at 60 C for 0.5, 1, 1.5, 2 hours of aminolysis and (2) at room temperature (RT) for 1, 2, 3, and 4 hours of aminolysis. Weight changes and spectrophotometer measurements showed a maximum in weight gain graph and K/S value curve indicating the highest PAMAM attachment at 60 C for 1 hour and RT for 2 hours which is considered as an optimum condition. Also, the emerging new peak around 1650 cm^{-1} corresponding to N-H bending vibration and double wide peak at around $3670\text{-}3170\text{ cm}^{-1}$ corresponding to N-H stretching vibration confirm PAMAM attachment in selected optimum condition. In the following, regarding the initial surface charge of grafted-PLA, lbl deposition was performed and started with PAA or PAMAM. FTIR-ATR results confirm chemical changes in samples due to deposition of the first layer (PAA or PAMAM). Generally, spectroscopy analysis indicated that an increase in layer number costed dye absorption capacity. It can be due to the partial deposition of a new layer on the previously deposited layer; therefore, the available PAMAM at the first layer is more than the third layer. In detail, in the case of layer-PLA starting lbl with negatively charged, having PAMAM as the first top layer (PLA-g-AA/PAMAM) showed the highest dye absorption of both cationic and anionic model dye.

Keywords : surface modification, layer-by-layer technique, dendritic materials, PAMAM, dye absorption capacity, PLA nonwoven

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