TAILORING HYDROPHILICITY OF POLY(BUTYLENE SUCCINATE) (PBS) COPOLYMERS

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Introduction

Poly (butylene succinate) (PBS), an aliphatic polyester with excellent mechanical properties and biocompatibility, has recently gained attention for medical applications [1]. Modification of the PBS properties, such as thermal, mechanical and biodegradability rate, can be done by introducing soft segments into the PBS as the co-monomeric units[2]. The copolymers of PBS-dimer linoleic acid (PBS-DLS) and PBS- poly(ethylene glycol) (PBS-PEG) can be found in literature and their tuneable properties was our motivation to introduce those three components in one copolymer structure [3,4]. In this work, the new copolymer of PBS-DLS-PEG with different ratio of the soft segments were synthesized by two step polycondensation. The hypothesis was to take advantage of PEG for improving the surface bio-functionality and wettability at simultaneous good mechanical properties.

Materials and Methods

PBS-DLS-PEG copolymers were synthesized by two step polycondensation. The weight ratio of the hard segments (PBS) was 70 wt.%, while the content of DLS and PEG1000 g/mol and 6000 g/mol, designated as PEG1000 and PEG6000, respectively has been varied from 0% to 30% wt.%. The chemical and mechanical characteristics of the new copolymers were evaluated by Fourier-transform infrared spectroscopy (FTIR), universal testing machine (in dry and wet conditions) and water contact angles. The water contact angle was measured by sessile drop shape analysis according to EN 828 using 2-µL ultra-pure deionized water drop on different areas of the samples. The hydrolytic degradability of the copolymers was also evaluated by immersing the samples into the PBS solution for 18 weeks at 37°C.

Results and Discussion

FIG. 1 represents the FTIR results for the new copolymers with PEG1000 and PEG6000. The results indicated the presence of PEG into the copolymers albeit slight differences can be seen in curves. The main differences can be seen at around 1100 cm^{-1} which is related to C-O stretching of the PEG.

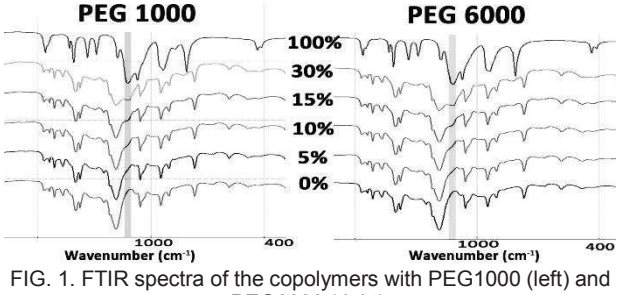

FIG. 1. FTIR spectra of the copolymers with PEG1000 (left) and PEG6000 (right).

FIGs 2 and 3 represent the pictures of the water drop onto the surface of the samples and water contact angles, respectively. The results clearly show the effect of PEG on increasing the wettability of the new copolymers. PEG6000 could make higher impact on wettability compared to PEG1000, that with 15% of PEG6000, the surface properties were varied from hydrophobic (without PEG) to hydrophilic surface.

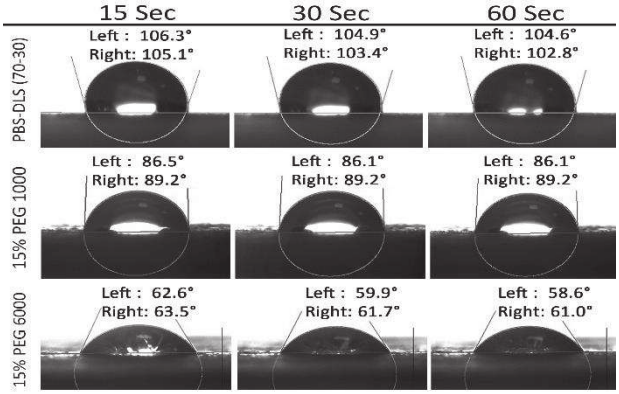

FIG. 2. Micro images of the drop of water onto the surface of the copolymers.

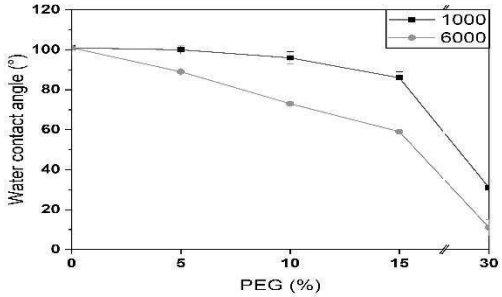

FIG. 3. Changes in water contact angles.

FIG. 4 shows the results from biodegradability after 18 weeks. Addition of PEG1000 slightly increased the biodegradability after week 6th while addition of PEG6000 had higher effect on biodegradability. Since biodegradability has a close relationship with surface hydrophilicity[5], as the presence of PEG600 had higher impact on increasing the wettability, it also had higher impact in increasing the biodegradability.

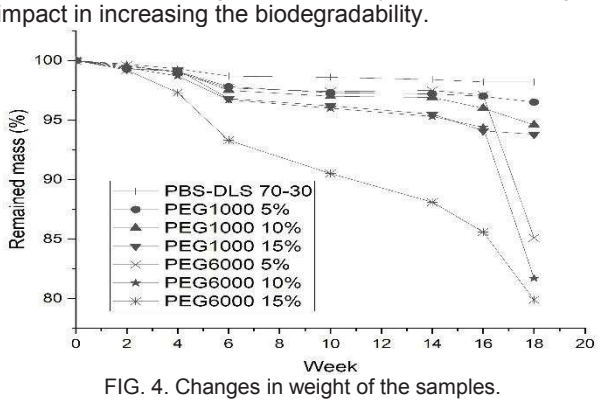

FIG. 4. Changes in weight of the samples.

Conclusions

Hydrophilic PEG1000 and PEG6000 soft segments were successfully introduced to PBS-DLS copolymers as confirmed by FTIR spectra. The water contact angle test showed that incorporation of PEG into copolymers improved hydrophilicity of new materials. Both hydrophobicity and degradation rate of the materials increased as a result of higher content and higher molecular weight of PEG soft segments.

References

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