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Electrospinning Drug-loaded Poly (Butylenes Succinate-co-bytylene Terephthalate) (PBST) with Acetylsalicylic Acid (Aspirin)

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Abstract: *Poly (butylenes succinate-co-bytylene terephthalate) (PBST) is electrospun into ultrafine fibers as delivery of acetylsalicylic acid (Aspirin) to treat wound. The diameters of the electrospun fibers vary from 100 to 500nm. The fibers are characterized by scanning electron microscopy (SEM), IR spectroscopy and High Performance Liquid Chromatography (HPLC), respectively. The results showed that Aspirin exists in the mixture in form of molecules and it can be released under proper conditions.*

Keywords: *electrospinning; PBST; Aspirin.*

I. INTRODUCTION

Electrospinning has attracted a lot of attention[1-10]. The electrospun nanobibers can be used for tissue engineering and drug carrier. So a variety of biodegradable materials have been investigated for their suitability in medicine carrier. Many biodegradable materials have been electrospun to nanofibrous mats, such as poly(lactide)(PLA), poly(lactide-co-glycolide)(PLGA) and poly (butylenes succinate)(PBS). Among the new aliphatic-aromatic copolyesters, PBST attracted particularly much more attention because it shares desirable biodegradability and good mechanical properties[11]

Zhang et al. studied the electrospinning of poly (vinyl alcohol) with acetylsalicylic acid(Aspirin)[12,13]. In this paper, we prepare for nanofibers mats as drug carrier by electrospinning. The chosen drug, acetylsalicylic acid (Aspirin), is one of the most effective antiplatelet agents and is now commonly used to prevent vascular event. It affects hemostasis by the inhibition of platelet function through acetylation of the cyclooxygenase [14]. It has antiphlogistic function and good potential uses in wound dressings (e.g. hemostatic bandages). In the field of tissue engineering, many scaffolding materials often induce an inflammatory response. If Aspirin is added to the material, it will restrain the situation. The base material for electrospinning is Poly (butylenes succinate-co-bytylene terephthalate) (PBST).

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II. EXPERIMENTAL PART

1. Materials

Poly (butylenes succinate-co-bytylene terephthalate) (PBST), Fig.1 (a), was supplied by Shanghai institute of organic chemistry (SIOC); acetylsalicylic acid (Aspirin), Fig.1 (b), was supplied by Shanghai Institute of Materia Medica (SIMM), Chinese Academy of Sciences (CAS); Analytical pure chloroform was used as solvent, obtained from Shanghai Chemical Reagent Co., Ltd. China. All material were used without further purification.

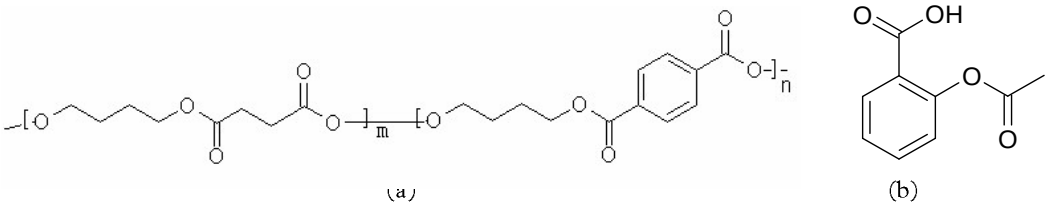


Fig.1: The Molecular Structures (a) PBST (b) Aspirin

2. Preparation of PBST/Aspirin Chloroform Solution

PBST particles were dissolved in chloroform solvent, then a control amount of Aspirin powder was drop into the mixture of PBST and chloroform with the weight ratio 1:2:20 (Aspirin: PBST: chloroform). The mixture of PBST, Aspirine and chloroform was magnetically stirred at 30°C for 4 hours.

3. Electrospinning Process

The electrospinning setup consists of a syringe, a needle, a grounded collecting plate and a high voltage supply. The tip-to-collection distance was 10cm. The voltage of 2KV was supplied to the needle . The mixture of PBST, Aspirine and chloroform was dropped into the plastic syringe and a dense web of fibers was collected on the plate.

4. Measurement and Characterization

SEM was performed to study the morphology of the electrospun fiber. Analysis of chemic components was studied through IR and HPLC investigation.

High Performance Liquid Chromatography (HPLC) is a chemistry based tool for quantifying and analyzing mixtures of chemical compounds, which is used to find the amount of a chemical compound within a mixture of other chemicals. An example would be to find out how much caffeine is in the cup of coffee (or tea, or cola). Chromatography is the term used to describe a separation technique in which a mobile phase carrying a mixture is caused to move in contact with a selectively absorbent stationary phase. The mobile phase is a solvent, which is pumped under high pressure through a column. The Stationary Phase is a finely divided solid held inside the column. Different components of the sample are carried forward at different rates by the moving liquid phase, due to their differing interactions with the stationary and mobile phases. The time every

component spends passing through the column will be recorded. Components can be identified according to the time recorded.

There are a number of different kinds of chromatography, which differ in the mobile and the stationary phase used. Here Agilent TC-C18 is chosen with acetonitrile and water as the mobile phase.

III. RESULTS AND DISCUSSION

1. SEM analysis

Fig.3 shows SEM pictures of the electrospun fibers. It can be seen that the diameters of the fibers ranged from 100nm to 500nm

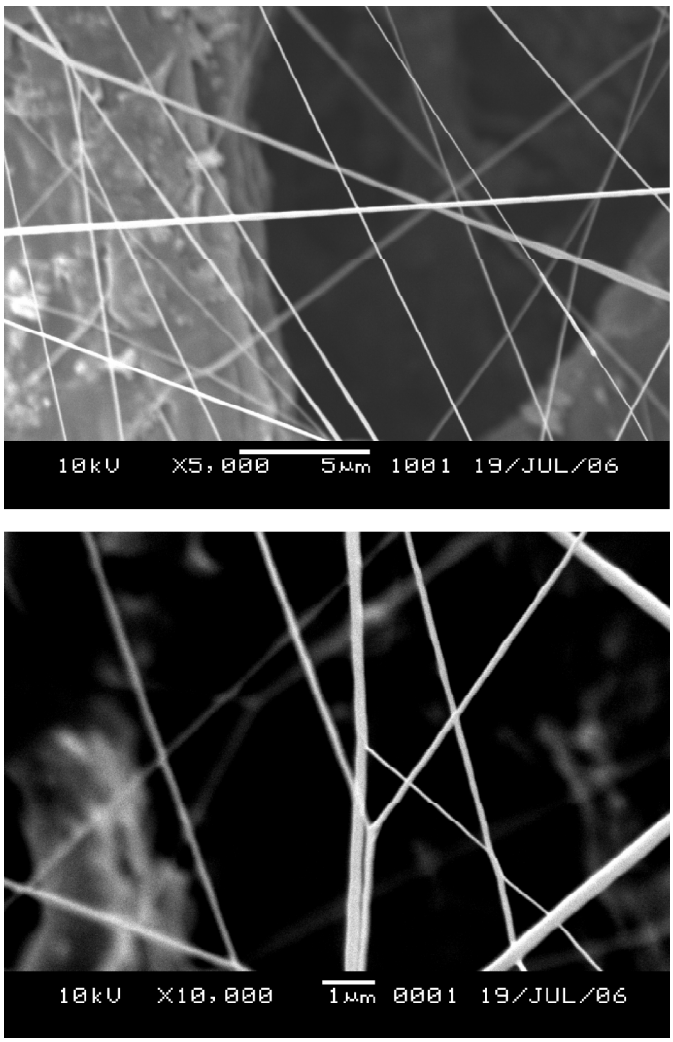
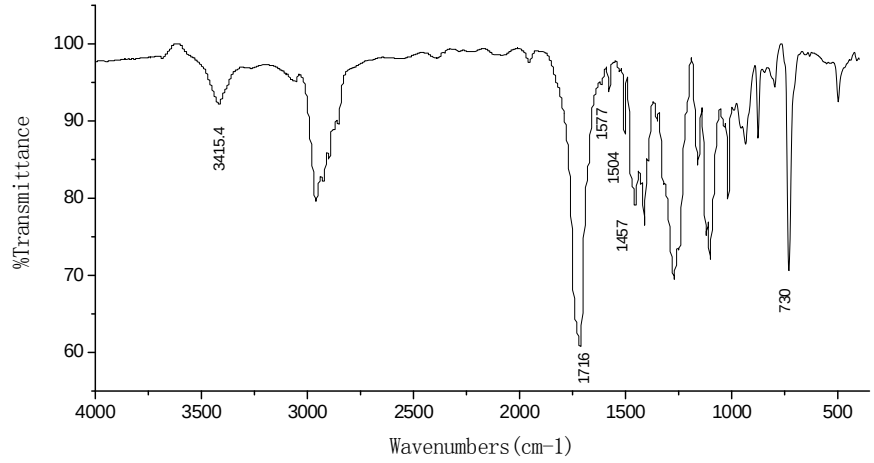


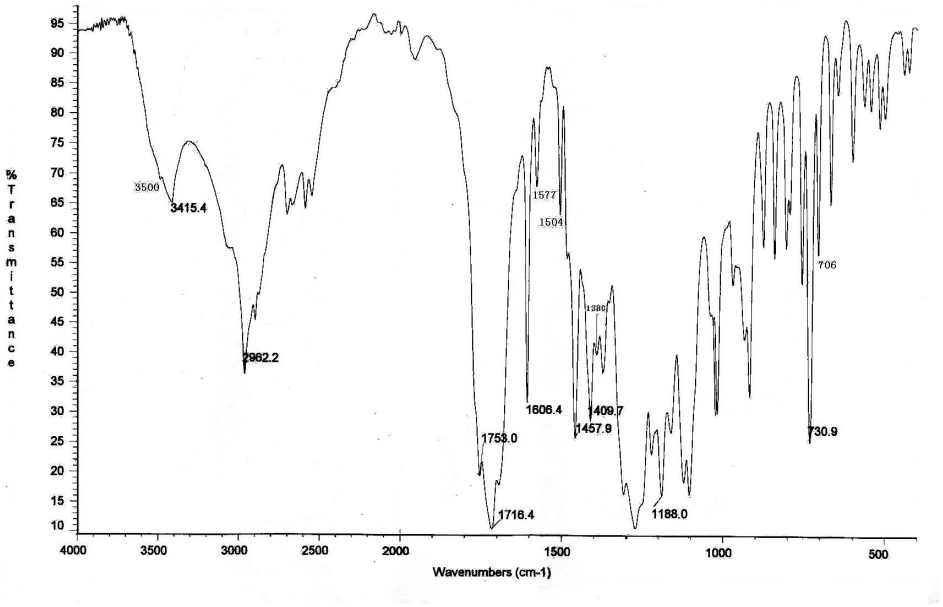
Fig. 3: SEM Pictures of the Electrospun Fibers

2. IR spectra

Fig. 4 displays the IR spectra for pure PBST fibers and the electrospun fibers. It is obvious that the absorption peaks at about 3415 cm-1, 1716cm-1, 1577cm-1 (1504 cm-1) assigned to hydratyl group (ν -oh), carboxy group (-co), benzene ring, respectively, correspond to pure PBST, see Fig. 4(a). In Fig. 4 (b), besides these peaks assigned to pure PBST , there are new peaks appeared at about 3500 cm-1, 1606 cm-1, 1380 cm-1, 1188 cm-1, 706 cm-1, corresponding to Aspirine.



(a)



(b)

Fig. 4: IR spectra for (a) pure PBST (b) the electrospun

3. HPLC analysis

In order to determine whether Aspirin exists in the electrospun fibers, HPLC for three kinds of samples were performed: the electrospun fibers, pure Aspirin and the mixture of the electrospun fibers and pure Aspirin. Fig. 5 shows the retention time obtained by HPLC. In Fig. 5(a), the main peak appeared at 2.20, which is a little different from the retention time for pure Aspirin, 2.19, in Fig.5(b). This difference may be due to the ambient. That means Aspirin exists in the electrospun fibers in form of molecules. To further verify it, we conducted HPLC analysis in the third sample, as shown in Fig. 5(c). Only one main peak appears in Fig. 5(c) and the corresponding retention time is 2.19, which is a clear evidence for the presence of the Aspirine in the electrospun fiber.

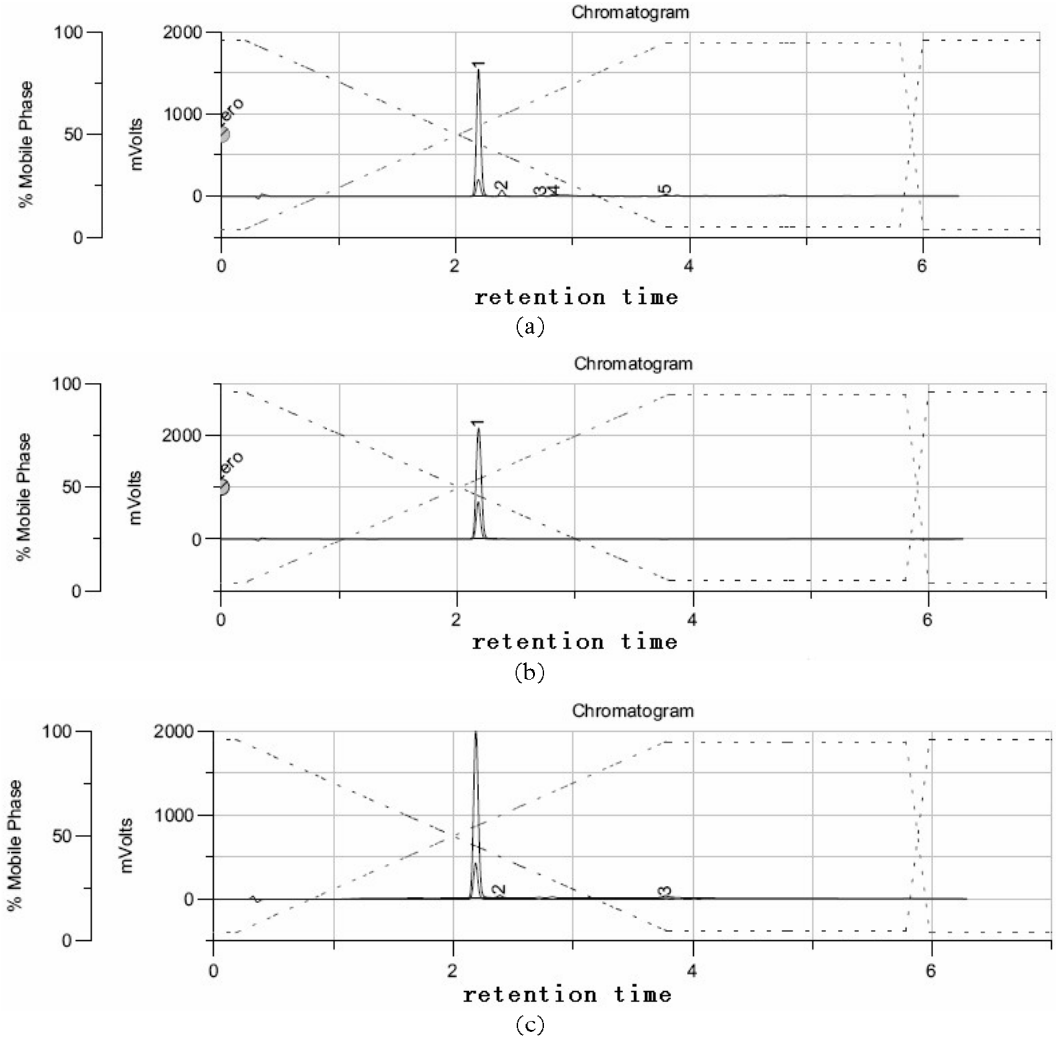


Fig. 5 HPLC Profiles of (a) the Electrospun Fibers (b) Pure Aspirin (c) the Mixture of the Electrospun Fibers and Pure Aspirin

IV. CONCLUSION

The results clearly show that the electrospun fibers are mixture of PBST and Aspirine. The diameters of the electrospun PBST/Aspirin nanofibers are 100-500nm. Furthermore, the result of IR spectra and HPLC analysis reveal that Aspirin exists in the mixture in form of molecules, so it can be released under proper conditions.

Acknowledgements

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Reference

[1] El Naschie MS. Nanotechnology for the Developing World, CHAOS SOLITONS & FRACTALS, 30 (4): 769-773 NOV 2006.

[2] Zeng YC, Wu Y, Pei ZG, Yu CW. Numerical Approach to Electrospinning, *International Journal of Nonlinear Sciences and Numerical Simulation*, 7(4)(2006) 385-388.

[3] He JH, Wan YQ. Allometric Scaling for Voltage and Current in Electrospinning, Polymer, 45(19) (2004) 6731-6734.

[4] He JH, Wan YQ, Yu JY. Allometric Scaling and Instability in Electrospinning, *International Journal of Nonlinear Sciences and Numerical Simulation*, 5(3)(2004) 243-252.

[5] He JH, Wan YQ, Yu JY. Application of Vibration Technology to Polymer Electrospinning, *International Journal of Nonlinear Sciences & Numerical Simulation*, 5(3) (2004) 253-261.

[6] He JH, Wu Y, Pan N. A Mathematical model for AC-electrospinning, *International Journal of Nonlinear Sciences & Numerical Simulation*, 6 (3)(2005) 243-248.

[7] He JH, Wan YQ, Yu JY. Scaling Law in Electrospinning: Relationship between Electric Current and Solution Flow rate , Polymer, 46 (8) (2005) 2799-2801.

[8] Wan, YQ, Guo Q., Pan N. Thermo- electro-hydrodynamic Model for Electrospinning Process, *International Journal of Nonlinear Sciences and Numerical Simulation*, 5(2004),5-8.

[9] Yue Wu, Jian-Yong Yu, Ji-Huan He and Yu-Qin Wan Controlling Stability of the Electrospun Fiber by Magnetic Field , Chaos, Solitons & Fractals, Volume 32, Issue 1, April 2007, Pages 5-7.

[10] Yu-Qin Wan, Ji-Huan He, Yue Wu and Jian-Yong Yu, Vibrorheological effect on Electrospun Polyacrylonitrile (PAN) Nanofibers, Materials Letters, Volume 60, Issue 27, November 2006, Pages 3296-3300.

[11] Li FX, Xu XJ, Li QB, Li Y, Zhang HY, Yu JY, Cao AM Thermal Degradation and their Kinetics of Biodegradable Poly (Butylenes Succinate-co-butylene terephthate) under nitrogen and air atmospheres, Polymer Degradation and Stability 91(2006) 1685-1693.

[12] Zhang CX, Yuan XY, Wu LL, Sheng J. Drug-loaded ultrafine poly (vinyl alcohol) Fibre Mats Prepared by Electrospinning, e-Polymer 2005 no. 027.

[13] Zhang CX, Yuan XY, Wu LL, Han Y, Sheng J. Study on Morphology of Electrospun Poly (vinyl alcohol) mats, European Polymer Journal 41 (2005) 423–432

[14] Jacqueline L. Coleman, Mark J. Alberts Effect of Aspirin Dose, Preparation, and Withdrawal on Platelet Response in Normal Volunteers, Am J Cardiol 2006; 98: 838-841.