Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 89 (2016) 313 – 317

Energy Procedia

CoE on Sustainable Energy System (Thai-Japan), Faculty of Engineering, Rajamangala University of Technology Thanyaburi (RMUTT), Thailand

Poly(vinyl alcohol)/multiwalled carbon nanotubes composite nanofiber

Jessada Wongon[a*], Supaphorn Thumsorn[b], Natee Srisawat[b]

[a] *Pathumwan Institute of Technology, Wangmai, Pathumwan, Bangkok, 10330, Thailand*
[b] *Kyoto Institute of Technology, Matsugasaki, Sakyo-ku, Kyoto, 606-8585, Japan*

Abstract

Composite nanofibers from poly(vinyl alcohol) (PVA) and multiwall carbon nanotube (MWCNT) were prepared by electrospinning technique. The contents of MWCNT were varied from 2-10 wt%. Since MWCNT aggregation has been easily occurred, surfactant was introduced for good dispersion of MWCNT in PVA/MWCNT composite nanofibers. MWCNT was dispersed in NaDDBS via ultrasonic technique in order to improve dispersion and prevent the aggregation of MWCNT in PVA solution. The effects of the surfactant, NaDDBS, and MWCNT contents on morphology of the composite nanofibers were investigated. From the results, it can be seen that NaDDBS improved the dispersion of MWCNT in the PVA solution. SEM photographs showed that the PVA/MWCNT composite nanofibers were smooth, which no bead was found in the composite nanofibers. The size of composite nanofibers was around 200-300 nm and the size of the composite nanofibers decreased when increasing MWCNT contents.

Peer-review under responsibility of the organizing committee of the 12th EMSES 2015

Keywords: carbon nanotube; dispersion; electrospinning; surfactant

1. Main text

Electrospinning uses an electrical charge to draw very fine (typically on the micro or nanoscale) fibres from a liquid. This technique is not complicate and is low cost. It can control the fibre production in terms of size and

* Corresponding author. Tel.: +66 2 219 3833 ext 260; fax: +66 2 219 3866 .
E-mail address: jadzila@gmail.com

Peer-review under responsibility of the organizing committee of the 12th EMSES 2015
doi:10.1016/j.egypro.2016.05.040

quantity. When a sufficiently high voltage is applied to a liquid droplet, the body of the liquid becomes charged, and electrostatic repulsion counteracts the surface tension and the droplet is stretched; at a critical point a stream of liquid erupts from the surface. The point of eruption is known as Taylor cone. If the molecular cohesion of the liquid is sufficiently high, stream breakup does not occur (if it does, droplets are electrosprayed). Therefore, the fiber can be produced via solvent evaporation and energy transferring to the environment [1].

Nanofiber is actually produced from many materials, especially from plastic. Various applications have been found. However, its property obtained from common nanofiber preparation method is not good enough. Some chemicals like reinforcement agent, surfactant were added into the process. The addition of carbon nanotube has been studied. The composite nanofiber was, therefore, produced with better property in terms of strength and conductivity [2]

The composite carbon nanotubes present good properties (mechanical, conductivity, heat, etc.) , however there is problem in the preparation step. Since, carbon nanotube aggregation have been easily occurred. Aggregation is occurred from Van der Waal force taken place between nanocarbon particles. The aggregation characteristics obtained from the SWCNT and MWCNT are shown in Fig. 1. It was found that the aggregation shapes of SWCNT and MWCNT were the bundle style and agglomerate style, respectively.

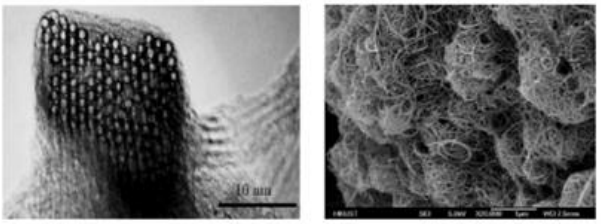

Fig. 1. SEM photographs of aggregation of Carbon nanotube. (a) SWCNT (b) MWCNT.

In addition, in the polymer processing step (polymer carbon nanotube), the composite product was not formed well, loose aggregation and low force between the polymer. These characteristics affect to the properties of the composite product (mechanical, heat, electricity, etc.). To overcome this problem, carbon nanotube should be dispersed totally without aggregation. The interaction force between carbon nanotube and polymer should be increased.

In this research work, sodium dodecylbenzenesulfonate (NaDDBS) surfactant was added into the carbon nanotube solution system. It reduced the surface tension of carbon nanotube, this reduction would reduce the aggregation phenomena of carbon nanotubes. Then, the polymer (PVA) was added subsequently into the dispersed carbon nanotube solution. The PVA/MWCNT composite nanofibers were produced by electrospinning technique. Moreover, the optimum conditions for electrospinning technique were studied.

2. Experimental

2.1. Materials

Multiwall carbon nanotube obtained from Arkema Co., ltd was used. NaDDBS and PVA (Mw. = 146,000-186,000) were obtained from Central Supply 2548.

2.2. Preparation of PVA/NaDDBS/ MWCNT

2.2.1 NaDDBS was dissolved in 100 ml DI water. Its concentration was 1% w/w. Magnetic stirring was done for 20 minutes.

2.2.2 MWCNT with amount as indicated in Table 1 was added into (2.1.1) solution. The particle disperse can be done by 5 min ultra sonication.

2.2.3 PVA with amount as indicated in Table 1 was added into (2.1.2) solution. The particle disperse can be done by 5 min ultra sonication.