Journal of ELECTRONIC MATERIALS, Vol. 42, No. 12, 2013
DOI: 10.1007/s11664-013-2816-4

Modification of Novel Conductive PEDOT:Sulfonated Polyimide Nano-Thin Films by Anionic Surfactant and Poly(vinyl alcohol) for Electronic Applications

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Conductive poly(3,4-ethylenedioxythiophene):sulfonated polyimide (PEDOT:SPI) nanoscale thin films were successfully developed by addition of anionic surfactant and poly(vinyl alcohol) (PVA) for potential application in electronic devices. In this work, sodium dodecyl sulfate (SDS) surfactant was introduced into PEDOT:SPI aqueous suspensions to improve the dispersion stability of the particles in water, leading to high transparency and low contact angle of PEDOT:SPI thin films. All of the conducting polymer thin films showed high transparency of more than 85% transmission. Conductivity enhancement and good film-formation properties of PEDOT:SPI were achieved by adding various amounts of PVA to each polymer aqueous suspension because of the resulting conformational changes. The highest conductivity of 0.134 S/cm was achieved at 0.08 wt.% PVA in PEDOT:SPI2/SDS/PVA film, increased by a factor of 3.5 compared with the original material. In addition, PVA also improved the thermal stability of the conductive films, as verified by thermogravimetric analysis (TGA). The interactions between conducting polymers, PVA, and SDS surfactant affecting nano-thin film properties were revealed and investigated. Moreover, the interactions between SDS and SPI were proven to be different from those between SDS and poly(styrenesulfonate) (PSS) in conventional PEDOT:PSS solutions.

Key words: Conductive materials, polymer, thin films, anionic surfactant, poly(vinyl alcohol)

INTRODUCTION

After the discovery of electrically conducting polymers (CPs) in 1977, they have become an interesting area in which huge efforts have been invested to develop commercial products for various applications, such as organic light-emitting diodes (OLEDs),[1] organic photovoltaic devices (OPVs),[2] capacitors,[3] and sensors[4] due to their light weight,[5] high conductivity, and electrochromic properties.[6] One of the most successful CPs commercialized worldwide is poly(3,4-ethylenedioxythiophene):poly (styrenesulfonate) (PEDOT:PSS) due to its many advantages, such as high conductivity,[7] high stability in the *p*-doped form,[8] good film-forming properties,[9] easy processing,[10] and excellent transparency in the visible range.[11] PEDOT:PSS is a polyelectrolyte complex formed during a polymerization reaction as a gel particle dispersed in water, consisting of conductive PEDOT (polycation) and insulating PSS (polyanion). The PEDOT joins the repeating units of the PSS via ionic interaction, and cannot be separated by electrophoresis.[12] The PSS segment in PEDOT:PSS does not contribute to charge transport directly but acts as a template to keep PEDOT in the

(Received February 9, 2013; accepted September 23, 2013; published online October 19, 2013)