Electronic Supporting Information

Facile preparation of robust and flexible antioxidant film based on self-polymerized dopamine in microporous battery separator

Manthiriyappan Sureshkumar, Pin-Ni Lee, Cheng-Kang Lee*

Materials

The microporous PE film (thickness 25 micron; porosity 40%) was purchased from Coin Nanotech Innovation Inc., Taipei, Taiwan and used without further treatment. 3-Hydroxytyramine hydrochloride (99%, $C_8H_{11}NO_2 \cdot HCl$) and 2,2-diphenyl-1-picrylhydrazyl (DPPH), NaOH and $AgNO_3$ (99.8%) were obtained from Acros (NJ, USA).

Preparation of antioxidant PE films

The PE film was treated with a 99% ethanol for few seconds for the preparation of wetted microporous surface. Original and pretreated PE films were immersed in the dopamine solution (2 mg ml^{-1} in Tris-HCl buffer (10 mM, pH 8.5)) for 24 h at RT, which autooxidize dopamine into adhesive polydopamine (Pdop). Subsequently, Pdop-coated samples were thoroughly washed several times with deionized (DI) water.

Peeling Test

A peeling test was conducted by applying a piece of Scotch tape (3M) strongly on the PE-Pdop films (surface coated and microslits-filled) and removing it quickly.

DPPH assay

The antioxidative activity of PE-Pdop films were measured using the DPPH radical method according to a procedure previously described[1]. H-transfer between antioxidative Polydopamine films and DPPH in a methanol solution was monitored by UV–vis absorption spectrometry at 512 nm (quartz cell length: 1 cm; solvent: methanol).

Determination of available phenolic groups on the modified film

In a microtube 0.75 mg of modified PE film and 0.12 mL of Folin-Ciocalteu reagent were placed and stirred for 3 min. Thereafter 0.24 mL of 12%Na2CO3 and 0.64 mL of water were added to a final volume of 10 mL. The reaction was kept at room temperature for 48 h. After that, the absorbance was determined at 760 nm. A calibration curve was prepared using garlic acid standard solutions. All determinations were performed in triplicate.

Stability test

To access the mechanical and chemical stability of flexible antioxidant films, PE-Pdop films were incubated under ultrasonic irradiation (LEO-801 Ultrasonic Steri-Cleaner) (0, 6, 12 and 15 W) for 2 min and in 0.1 N NaOH for 24 h respectively. After incubation DPPH assay was carried out to access the antioxidant efficiency.

In-situ Silver nanoparticles (SNPs) preparation

PE-Pdop film is immersed in 50 mM of $AgNO_3$ solution in dark for 18 h at RT, dissolved metallic silver ions were converted into SNPs by multifunctional groups presents on the surface of Pdop.

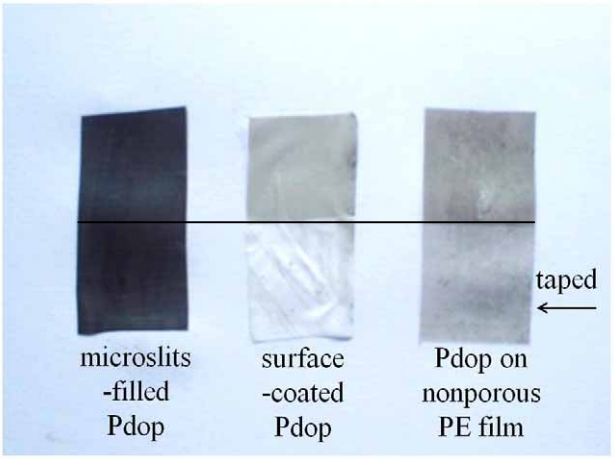

Fig 1S. Scotch peeling test of Pdop modified porous PE (microslits filled and surface coated) and nonporous PE films

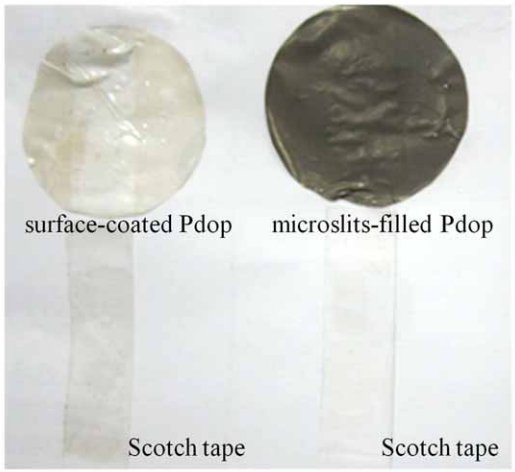

Fig 2S. Pdop modified porous PE films (surface coated and microslits-filled) after applying Scotch tape peeling test.

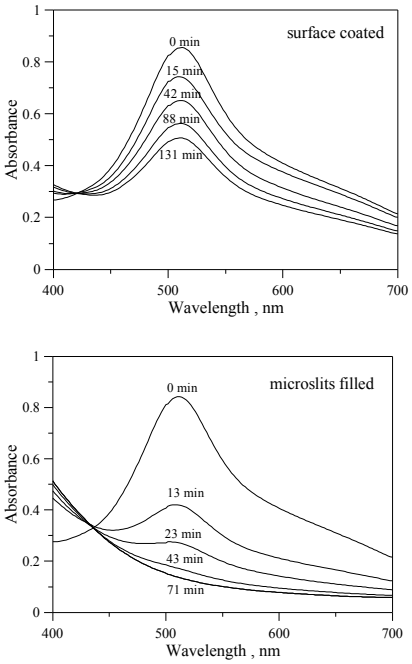

Fig 3S. DPPH activity of surface coated and microslits filled PE-Pdop samples.

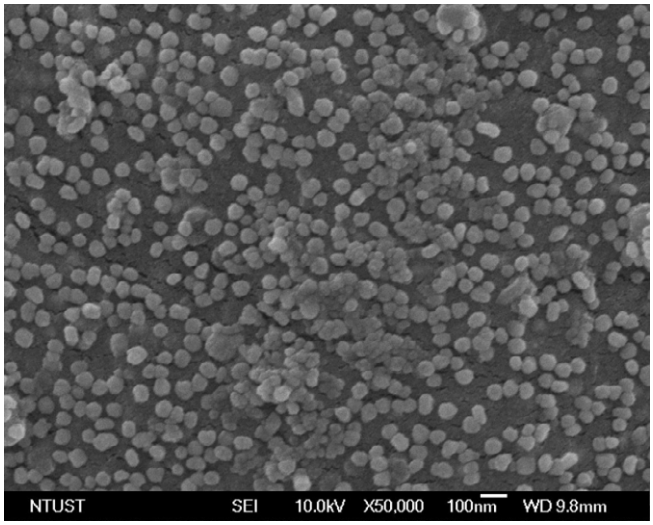

Fig 4S. FE-SEM image of silver nanoparticles (SNPs) generated on the surface of Pdop coated PE film

1. E. Portes, C. Gardrat, A. Castellan and V. Coma, *Carbohydrate Polymers*, 2009, **76**, 578-584.