

Electronic Supplementary Information for

Low-cost, high-conductive polyvinyl alcohol flexible films with Ag-microsheets and AgNWs as fillers

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Experimental Section

Fabrications of the Ag-microsheets

The Ag-microsheets was synthesized using silver nitrate, PVP and ammonium iron (II) sulfate, without further purification. In a typical synthesis, a total of 30 mmol of AgNO₃ and 35 mmol of PVP were mixed in 200 mL of water under vigorous magnetic stirring at room temperature for 30 min. After AgNO₃ and PVP were completely dissolved, 50 mL of ammonium iron (II) sulfate solution (0.2 M) was added into the mixed solution. The mixed solution then became grey black, indicating the formation of metallic silver powder. After 1 h, the products were harvested by centrifugation, washed several times with deionized water and ethanol. Finally, the product was dried in air at 60 °C for 12 h.

Preparation of PVA conductive films

A PVA solution was prepared through the dissolution of 5 g of PVA in 40 mL of deionised water under constant stirring at 50 °C for completely dissolved. The AgNWs/PVA solution was prepared through the dissolution of 5 g of PVA in 40 mL of AgNWs solution (12.5 mg/mL and 18.75mg/mL) under constant stirring at 50 °C for 5 h. Similarly, the Ag-microsheets/PVA was also prepared through the dissolution of 5 g of PVA in 40 mL of Ag-microsheets solution (25 mg/mL and 37.5 mg/mL) under constant stirring at 50 °C for 5 h. The Ag-microsheets/AgNWs/PVA solution was prepared through the dissolution of 5 g of PVA in 40 mL of Ag-microsheets (6.25

mg/mL) and AgNWs (12.5 mg/mL) under constant stirring at 50 °C for 5 h. Thereby we can achieve a stable and uniform Ag-microsheets/PVA, AgNWs/PVA and Ag-microsheets/AgNWs/PVA solutions. Once uniformly mixed, these solutions were poured into the Teflon plates. The Teflon plates were subsequently placed in the oven cured for about 1 h at 100 °C to give the conductive films and the conductive films formulations are listed in Table 1.

Table 1 Formulations of the nanocomposites conductive films.

Sample	PVP (g)	Water (mL)	Ag-microsheets (g)	AgNWs (g)
AgNWs/PVA-10%	5	40	0	0.5
AgNWs/PVA-15%	5	40	0	0.75
Ag-microsheets/AgNWs/PVA	5	40	0.25	0.5
Ag-microsheets/ /PVA-20%	5	40	1	0
Ag-microsheets/ /PVA-30%	5	40	1.5	0

Material characterization

The structural analysis of the sample was performed using powder X-ray diffraction. The morphologies of the products were observed using a TESCAN 3400N scanning electron microscope. Mechanical tensile tests were performed on a universal testing machine (AG-IC10 KN), at 25 °C and around 45 % RH. Electrical conductivities of the products were measured by four point method with Kunde KDY-1 system.