

Supporting Information

Experimental details

1. Materials

Single-walled CNTs with diameter 1-2 nm, length ~ 30 μm , -COOH content 2.73% (by mass), and purity 90% were purchased from Chengdu Organic Chemicals Co. Ltd., Chinese Academy of Sciences, and used as-received. PVB resin was purchased from Sigma-Aldrich (Butvar B-98) whose hydroxyl content (expressed as % polyvinyl alcohol) is about 18-20% and molecular weight about 40,000-70,000. Absolute Ethanol was purchased from Merck.

2. Preparation of CNT/PVB composite films

To prepare CNT/PVB composite films, CNTs and PVB were dispersed in ethanol with the aid of ultrasonication. The total concentration of PVB and CNT was fixed at 0.2 mg/ml, while the mass percent of CNT was allowed to vary from 0 to 80 wt%. The CNT/PVB ethanol solution was injected to the surface of water-ethanol mixture by a syringe pump (model 781100, Kd Scientific), where the volume ratio of water to ethanol was around 7:3. Subsequently, the CNT/PVB composite film formed on the surface of water-ethanol solution. The transparent CNT/PVB composite films can be easily transferred onto a transparent matrix, such as glass and flexible polymer, by parallel dipping (and pulling) the substrate onto the film surface. Flexible polyethylene terephthalate (PET) films and glass were used as substrate, respectively, in subsequent electrical and optical characterization. The substrates were cleaned by ethanol before using, and dried at 60°C for 30 min after dip coating.

3. Characterization

The surface morphology of CNT/PVB composite films was characterized by a JEOL JSM-6700F field-emission scanning electron microscopy (FESEM). Samples were sputter-coated with platinum prior to observation. The optical properties of the CNT/PVB composite films coated on glass were studied by using a Shimadzu UV-2450 spectrophotometer in the range of 250-900 nm with a 1-nm interval. Electrical properties of the CNT/PVB composite films coated on PET films were measured at room temperature with an Agilent semiconductor analyzer. All samples were cut into strips of 20 mm \times 2 mm.