Supporting information

Large Scale Aligned Carbon Nanotubes from Their Purified, Highly Concentrated Suspension

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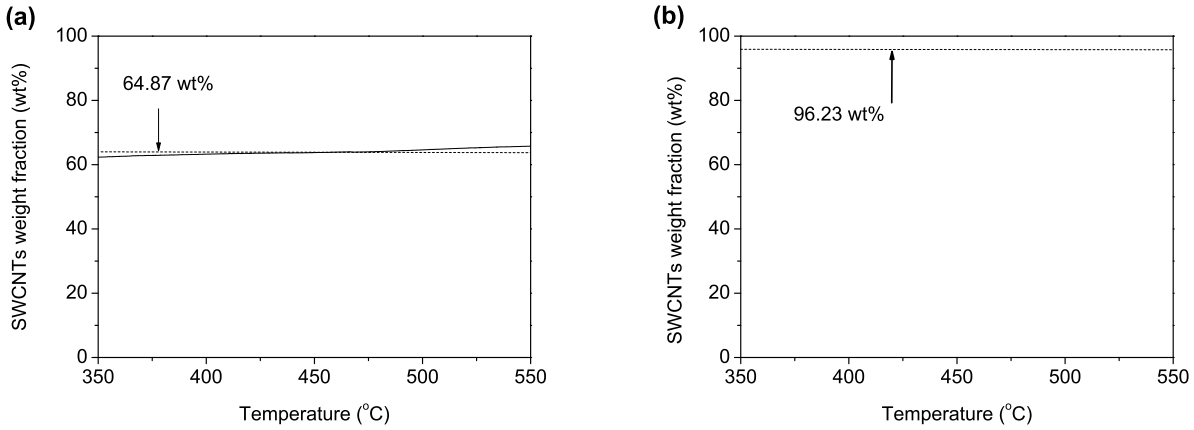

Figure S1. Weight fractions of SWCNTs in the dried supernatant (a) and carbonaceous impurities in dried precipitate (b) calculated from TGA curves in the range between 350 ^{o}C and 550 ^{o}C, solid lines are calculated results and dash lines are average values.

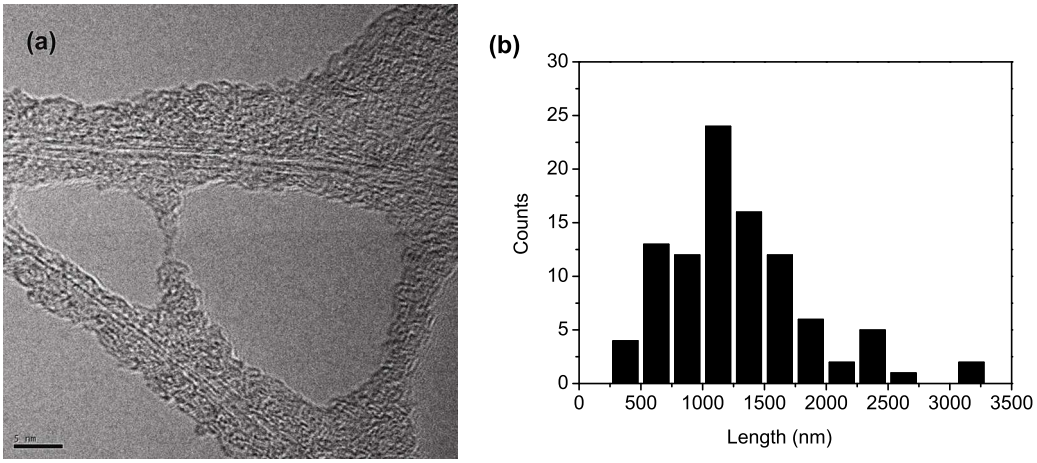

Figure S2. (a) TEM images for as purified SWCNTs, scale bar 5 nm; (b) length distribution of sonication dispersed SWCNTs

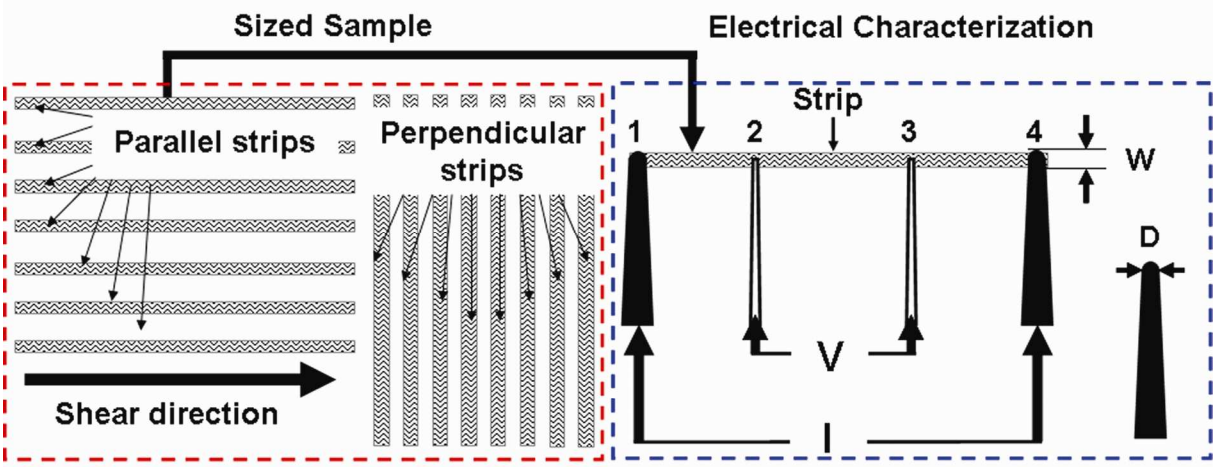

Figure S3. Schematic illustration of the four-probe characterization of aligned SWCNT composite strip; W is the width of the strip; D is the diameter of the probes

Weight fractions of both SWCNT in the dried supernatant and carbonaceous impurities in the dried precipitate were calculated from the TGA data (Figure 4 in the text) following the reported calculation method [32]. By choosing the start point of 150 ^{o}C residual water is totally removed and only gellan gum and nano particles remain. To obtain more reliable results from the curves, we calculated the weight fractions in a temperature range between 350 ^{o}C and 550 ^{o}C, rather than one or several points, as shown in figure S1 and calculated an average value from this data. From the TGA data, we can see that the range we adopted shows no obvious weight loss of raw SWCNT powder that contains SWCNTs and carbonaceous impurities in nitrogen gas. Therefore we do not need to consider the influence of the different mass ratio of SWCNT and carbonaceous impurities in supernatant or precipitate on the weight fraction calculation. The calculated total weight of SWCNTs in collected supernatant and carbonaceous impurities in precipitate are 46.0 mg and 50.3 mg respectively. There is about 3.7 mg weight loss from 100 mg raw SWCNT powder. We attribute this to the weight loss during the collection process.

Here we feel it is necessary to mention that the SWCNTs are mostly not mono dispersed after such a short duration of sonication treatment. The purpose of using sonication treatment to disperse SWCNTs is to separate them into small units that can be stabilized for periods of months or longer, which allowed the transition of isotropic phase of SWCNTs to anisotropic phase. The SWCNTs have been dispersed into very small bundles that wrapped by gellan gum forming core shell units as shown in figure S2a. The length distribution of the core shell units calculated from their FESEM images has been shown in figure S2b. Their average length is about 1.3 micrometer. Though previous report show that long time sonication could further de-bundle SWCNTs, the length of mono dispersed SWCNTs is seriously shortened into hundreds or even tens of nanometers [27], which is not favorable for the formation of the SWCNT liquid crystal phase. Thus we don't further disperse SWCNTs in our experiment.

As has been shown in figure S2, small SWCNT bundles are normally wrapped by polymer gellan gum forming core-shell structure. The aligned SWCNTs in composite membrane observed by FESEM are those imbedded in the polymer

matrix. The polymer gellan gum seriously lowers the contrast of FESEM images, making the observation of the SWCNTs in polymer matrix a hard work especially when SWCNTs are neatly aligned. To obtain better image contrast, we normally use a 30 kV maximum operation voltage, which provides relative higher contrast for more information of deeper layer.

The electrical characterization is based on a four-probe system as illustrated in figure S3. Before characterization, composite membrane on glass substrate was sized into 0.1 mm wide and 5 mm long strips parallel and perpendicular with the SWCNT sheared direction. During the characterization, electrical current was swept from -1 to 1 mA through the probe 1 and 4. The probe 2 and 3 recorded the potential fall between them. This system has been widely used to obtain accurate impedance readings for membranes by eliminating the contact resistance from the measurement. The diameter of the probe 1 and 4 is the same as the strip width, giving a uniform electric field along the strip. The distance between the probe 2 and 3 is 1 mm and the distance between probe 1 and 4 is 3 mm.