Supplementary Material

Figure S1 (a) shows the SEM image of the paper substrate (top view). The cross sectional SEM images of paper and polyimide (PI) substrates, which were used in our sensors, are shown in Figure S1 (b) and (c), respectively. It is clear that paper's surface is much rougher than PI's surface.
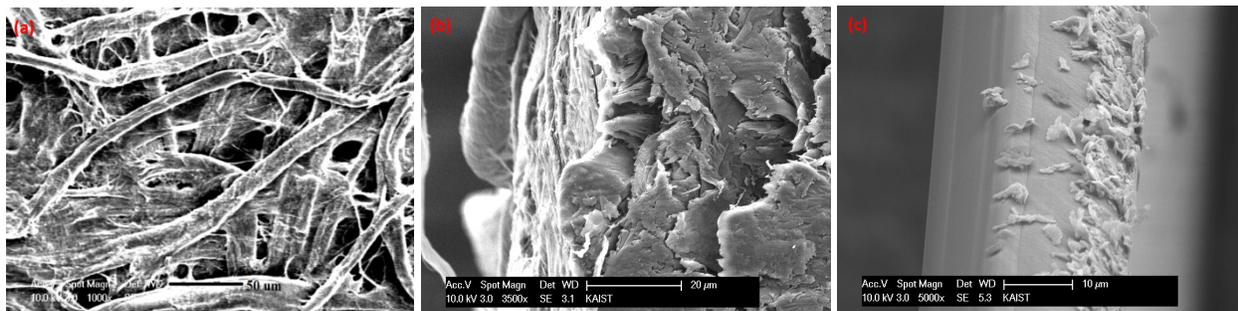
Figure S1. SEM images of the bare paper substrate: (a) top view (b) cross sectional view. (c) Cross sectional SEM image of the polyimide (PI) substrates

Effect of secondary solvent; UV-Visible spectroscopy

There have been a lot of debates on whether polyaniline is even soluble in any solvent or it merely can form a very well dispersed suspension (with very fine particles ~ 5 nm in size). In either case, selecting a good solvent can increase the solubility (or dispersibility) of PAni inside the solution. UV-Visible spectroscopy is an effective method to compare the undissolved and suspended contents of two or more solutions with each other. Having two colorless solutions, one can compare the amount of dissolved/undissolved contents in the two solutions by comparing their UV-Visible absorbance spectra. This experimental method was used to investigate the effect of the secondary solvent, tetrahydrofuran (THF), on increasing/decreasing the solubility of PAni in chloroform. To investigate this effect we prepared two different solutions. In the first solution, 25 mg of PAni was dissolved in 10 ml chloroform and in the second solution, 25 mg PAni was dissolved in 8.5 ml chloroform plus 1.5 ml THF. The two solutions were kept in room temperature under high RPM magnetic stirring condition for at least 12 hours. Afterwards, a small amount of each solution was diluted with chloroform to obtain solutions with 0.125 mg/ml PAni to chloroform concentration. In this concentration, the solutions were colorless. The solutions were afterwards filtered with a 0.45 micron PTFE syringe filter. The two solutions before and after filtering are shown in Figure S2. UV-Visible spectroscopy was done on all of the four filtered and unfiltered solutions and the results are shown in Figures S3. The lower absorbance of the solution containing 15 weight percent of THF shows that this solution has much less suspended or undissolved PAni. In other words, PAni's solubility is higher in the solution that contains THF. This shows that adding THF yields higher solubility of PAni.
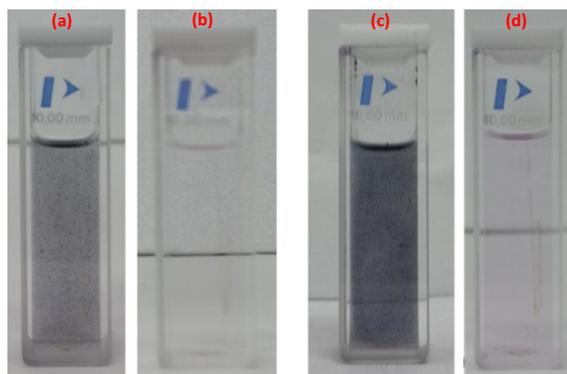
Figure S2. PAni dissolved in 15 wt% THF in CHCl$_3$ before filtration (a), after filtration (b), and PAni dissolved in pure CHCl$_3$ before filtration (c), after filtration (d)
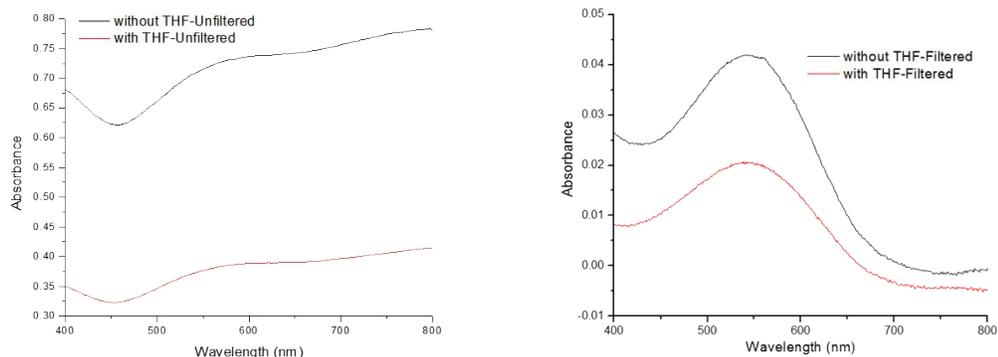
Figure S3. UV-Visible spectra of the two solutions (solutions with and without THF) before (left side) and after (right side) filtration

Electrical measurement was done by a semiconductor parameter analyzer. The I-V curve is shown in Figure S4. The resistance of the sensors in ambient air (in 65% relative humidity) are around 1 MΩ (for fibers electrospun on PI substrate) and 1.5 MΩ (for fibers electrospun on paper substrate). The resistance of the sensing materials that were deposited on the interdigitated electrodes shown in Figure 10(b) and (e) with 150 µm electrode gap, were measured. One of the reasons for obtaining higher resistance for paper sensor is relatively high resistance of carbon electrodes compared with gold electrodes.
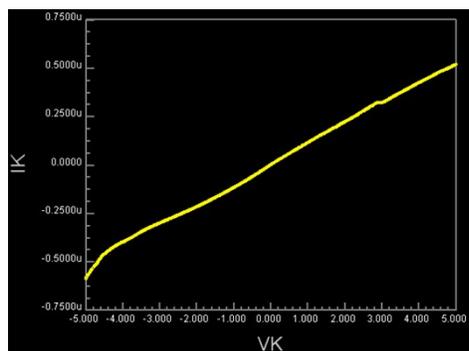
Figure S4. I-V curve of doped PAni-PEO nanofibers deposited on paper substrate for 3 minutes

The sensor was placed in an enclosed chamber and dry air (with a constant flow rate of 200 SCCM) was flowed into and out of the chamber. Base resistance of the sensor was measured in real time by a source meter. The result is shown in Figure S5. The sensor shows an almost constant resistance of around 6.3 MΩ during a period of more than 8 hours. This indicates the drifting in the base resistance of the sensor is negligible.
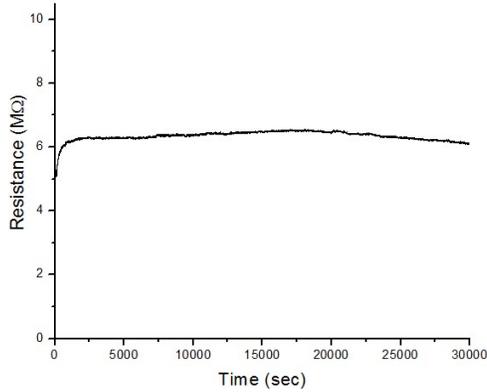
Figure S5. Base resistance drifting test

A statistical analysis was performed on nanofibers deposited on paper and polyimide substrates. The diameters of nanofibers were measured on 30 points in Figures 5 (b) and (g). The distribution of count of diameters is displayed in Figure S6-7. The nanofibers deposited on the PI have more uniform diameter (lower standard deviation) than those deposited on the paper. The center of the distribution (median=295.5 for PI and 375 for paper) is closer to the average (mean=293.3 for PI and 382.3 for paper) for PI substrate and the standard deviation is smaller for this substrate (SD= 83 for PI and 101 for paper).Also, the range (max-min= 330 for PI and 355 for paper) is smaller for PI substrate. All of these statistical analyses indicate that nanofibers have a more uniform diameter on PI substrate and are thinner in average on this substrate compared with the paper substrate.

Min	Max	Average	Std Dev	Median	Range
90	420	293.3	83.1	295.5	330
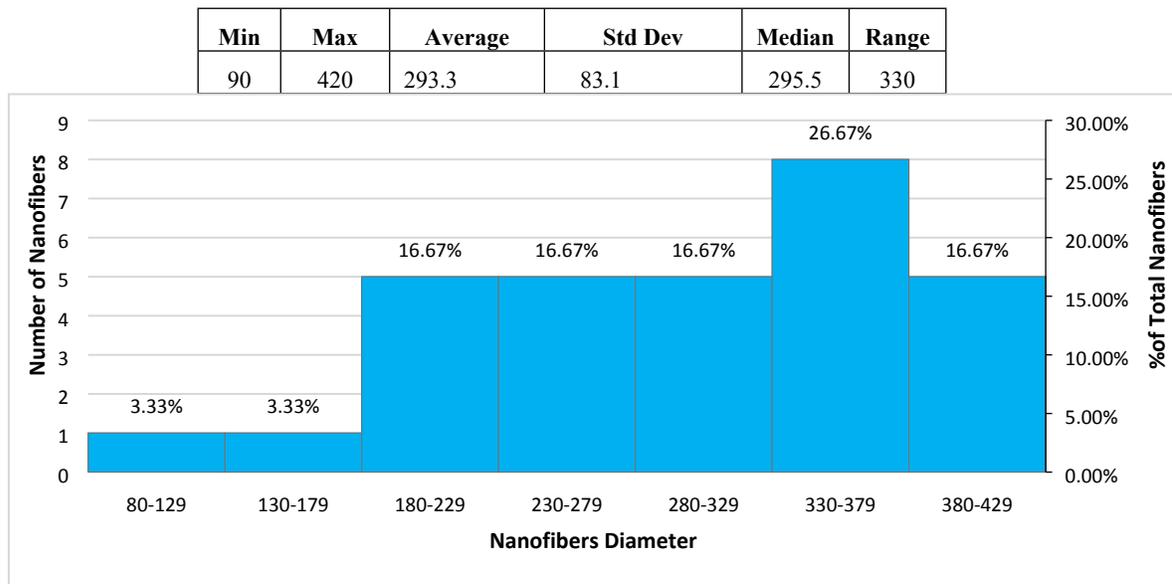
Figure S6. Statistical analysis of nanofibers deposited on the PI substrate based on Figure 5(g). After calculating the

nanofibers diameter in 30 points, distribution of diameters has been analyzed.

Min	Max	Average	Std Dev	Median	Range
225	580	382.2	101.1	375	355
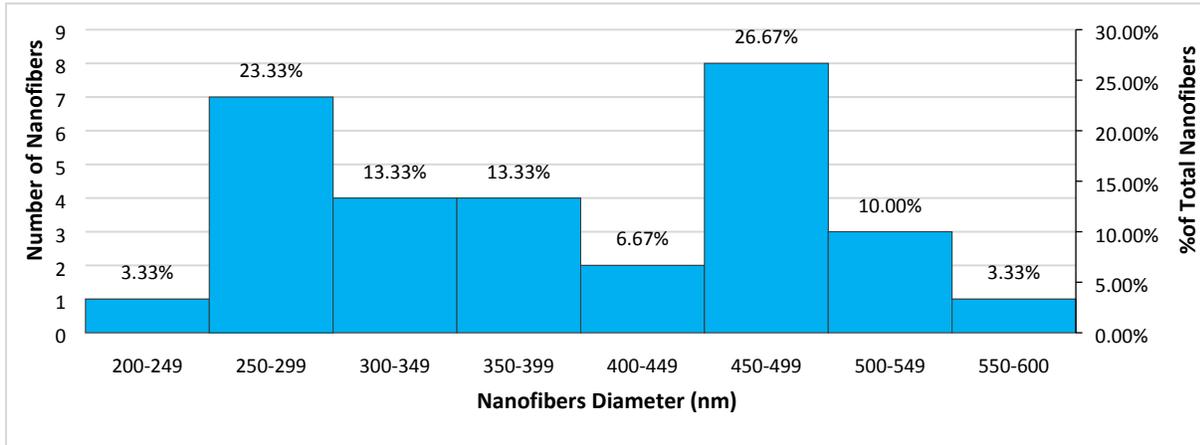
Figure S7. Statistical analysis of nanofibers deposited on the paper substrate based on Figure 5(b). After calculating the

nanofibers diameter in 30 points, distribution of diameters has been analyzed