Supplementary Information

Self-doped polyaniline derived from poly(2-methoxyaniline-5-phosphonic acid) and didodecyldimethylammonium salt

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Calculation of the composition

The structure of the obtained mixture in the experiment can be drawn as shown in Fig. S1.

Fig. S1. Structure of the mixture.

Here, \( W(\text{Atom or Molecule}) \) means the percentage of weight (wt%) for “Atom or Molecule” in the above mixture. \( M_n(\text{Molecule}) \) and \( A_n(\text{Atom}) \) mean molecular weight and atomic weight for “Molecule” and “Atom”, respectively.

**PMAP-DDDMA before washing**

\[
W(P) = \left[ \frac{1.75 \times (20/1000)}{1.9068 \times 100} \right] = 1.835 \text{ wt%}
\]

The value of ppm for phosphorus was obtained from the ICP-AES analysis [1.75 ppm (average number of the three experiments) in the concentrated nitric acid solution of the above mixture (1.9068 mg in 20 mL)].
W(Br) = 8.76 wt%, the value was obtained from the ion-chromatography.
W(O) = 100-[W(C)+W(H)+W(N)+W(Br)+W(P)] = 8.68 wt%, the values for W(C), W(H) and W(N) were obtained from the elementary analysis {W(C), W(H) and W(N) = 65.58, 11.88 and 3.70 wt%, respectively}.

\[
m = \frac{W(\text{DDDMABr})}{W(P)}/M_w(\text{DDDMABr})/A_w(P)
\]

\[
M_w(\text{all}) = M_w(\text{monomer})+(1+x)*M_w(\text{DDDMA}^+)+(0.5-x)*A_w(H^+)+m*M_w(\text{DDDMABr})+n*M_w(H_2O)
\]

W(O)=100*[4*A_w(O)+n*A_w(O)]/M_w(\text{all}), because oxygen is included in the components for monomer and H_2O in the above mixture.

W(P)= 100*A_w(P)/M_w(\text{all})

From the above two equations concerning the percentage of weight for oxygen and phosphorous, \(x\) and \(n\) were calculated.
i.e. 
\[
M_w(\text{all}) = 100*A_w(P)/W(P)
\]

\[
n = \frac{W(O)*M_w(\text{all})-100*4*A_w(O))/(100*A_w(O)) = \frac{W(O)*100*A_w(P)/W(P)-100*4*A_w(O))}{100*A_w(O)}
\]

\[
x = \frac{M_w(\text{all})-M_w(\text{monomer})-M_w(\text{DDDMA}^+)-0.5*A_w(H^+)-m*M_w(\text{DDDMABr})-n*M_w(H_2O})/M_w(\text{DDDMA}^+)-A_w(H^+)
\]

\[
= 0.431
\]

Therefore, molecular formula of the above mixture is described as shown below.

C_{92.32}H_{199.22}N_{4.28}O_{8.70}P_{1.06}Br_{1.85}

The percentage of weight for each element is described as shown below (elementary analysis).

C, 65.71; H, 11.90; N, 3.55

Cf. the experimental values: C, 65.58; H, 11.88; N, 3.70.

**PMAP-DDDMA after washing**

W(P) = [3.50*(20/1000)]/2.1865*100 = 3.20 wt%, the value of ppm for phosphorus was obtained from the ICP-AES analysis [3.50 ppm (average number of the three experiments) in the concentrated nitric acid solution of the above mixture (2.1865 mg in 20 mL)].

W(Br) = 5.43 wt%, the value was obtained from the ion-chromatography.
W(O) = 100 - {W(C) + W(H) + W(N) + W(Br) + W(P)} = 11.74 wt%, the values for W(C), W(H) and W(N) were obtained from the elementary analysis {W(C), W(H), and W(N) = 64.38, 11.16 and 4.09 wt%, respectively}.

The values for m, n and x were calculated in the same way as PMAP-DDDMA before washing. 

\[ m = 0.66, \quad n = 3.10 \quad \text{and} \quad x = 0.0660 \]

Therefore, molecular formula of the above mixture is described as shown below.

\[ \text{C}_{51.81}\text{H}_{109.14}\text{N}_{2.72}\text{O}_{7.10}\text{P}_{1.08}\text{Br}_{0.66} \]

The percentage of weight for each element is described as shown below (elementary analysis).

C, 64.32; H, 11.37; N, 3.94

Cf. the experimental values: C, 64.38; H, 11.16; N, 4.09.

Fig. S2 Pictures of PMAP-DDDMA (a) before and (b) after washing in various solvents (from left to right, diethyl ether, ethyl acetate, DMSO, CH\textsubscript{2}Cl\textsubscript{2}, ethanol, 2-propanol, acetone, hexane, toluene and THF ).
Fig. S3 Photos of spin-coated film of PMAP-DDDMA before (left) and after (right) washing on glass substrates.