Supporting Information

A Novel Fluorescent Polymer Brushes Film as A Device for Ultrasensitive Detection of TNT

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**Figure S1.** The UV absorption spectra of d-TPE solution before \((1\times10^{-3}\text{ mol/L, } 3\text{ mL})\) (solid line) and after (dotted line) interacting with the PAA brushes film. The absorbance were 0.97262 and 0.94525, respectively. According to the Bouguer–Lambert–Beer law: \(A=\lg(1/T)=Kbc\), \(A_1/A_2=C_1/C_2, C_2=9.719\times10^{-4}\text{ mol/L}\). \(C=C_1-C_2=2.814\times10^{-5}\text{ mol/L}\), the amounts of d-TPE molecular self-assemble on the brushes film was \(8.442\times10^{-8}\text{ mol}\).\((2.814\times10^{-5}\text{ mol/L}\times0.003\text{ L})\)
**Figure S2.** The structure of tetraphenylethene derivate (d-TPE) was confirmed by $^1$H NMR spectroscopy in D$_2$O. The proton chemical shift at 7.21 ppm was assigned to the phenyl ring and the shift at 4.34 ppm could be attributed to the chemical shift of -CH$_2$- in 1-methoxy-4-methylbenzene. The proton chemical shift at 3.196 ppm was attributed to the -CH$_2$- in methylethanaminium bromide and the shift at 1.36 ppm assigned to the proton in methyl groups. All structures indicates the origin of monomer tetraphenylethene derivate (d-TPE).
Figure S3. The excitation (EX) and emission (EM) spectra of d-TPE molecules aqueous solution. Insert shows the structure of d-TPE molecule.
Figure S4. The emission spectra of d-TPE/PAA brushes film (blue line) and d-TPE molecules aqueous solution ($10^{-3}$ M) (black line), ($\lambda$ ex = 340 nm).
**Figure S5.** The normalized fluorescence recovery cycles of free d-TPE molecules with TNT concentration between 0 and 1 ppb. Compared with the d-TPE combining with PAA brushes, the free d-TPE molecules can be washed off easily from the substrate, which indicated that the free d-TPE molecules cannot show a good recovery cycles character.
Figure S6. The normalized emission spectra of d-TPE/PAA brushes film with different TNT concentration of 0 ppb and 1 ppb. Each cycle is corresponding to the brushes film washed by methanol and annealed in vacuum at 60 °C for 2 hours after immersed in TNT aqueous solution. The measurements are 10 cycles, (λ ex = 340 nm).
Figure S7. The normalized emission spectra of d-TPE/PAA brushes film with water, varying concentrations of NaCl aqueous solution ($10^{-3}$ M, $10^{-2}$ M, $10^{-1}$ M). The d-TPE/PAA brushes film exhibited a stable fluorescence to varying NaCl concentrations.
Figure S8. The normalized emission spectra of d-TPE/PAA brushes film with water, aqueous solution of NaCl ($10^{-2}$ M) and various concentrations of TNT (0-200 ppb) in aqueous solution of NaCl ($10^{-2}$ M) ($\lambda_{\text{ex}} = 340$ nm). The brushes film shows good fluorescence stability and highly sensitive to TNT in NaCl aqueous solution.
Figure S9. Plot of normalized PL intensities of d-TPE/PAA brushes film versus various TNT concentrations (0 – 0.5 ppb) in aqueous solution of NaCl (10^{-2} M). It shows a linear relationship (R=0.99101) between PL intensity and TNT concentration.