# Supporting Information

Figure s1 shows the SANS data of SDS-$D_2O$ system used in this paper. Figure s2 shows the Holtzer plot of the SANS data of P3TMAHT(SDS-$d_{25}$)$_x$-$D_2O$ with $x$=1/5, 1/2, and 5. Figure s3 shows comparison of $p(r)$ functions as calculated for P3TMAHT(SDS)$_x$-$D_2O$ and P3TMAHT(SDS-$d_{25}$)$_x$-$D_2O$ for $x \leq 1$. Figure s4 shows the photoexcitation spectra of 0.1 mg/mL P3TMAHT-$D_2O$ and P3TMAHT(SDS)$_x$-$D_2O$ with $x$=1/5-5.

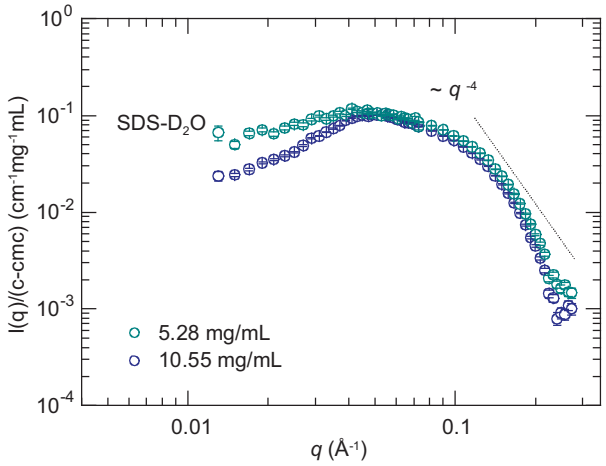


**Figure s1.** SANS data of SDS-$D_2O$ at concentrations 5.28 mg/mL (open cyan circles) and 10.55 mg/mL (open blue circles). Dashed line shows a -4 decay for comparison. $T$=20 $^{o}$C.

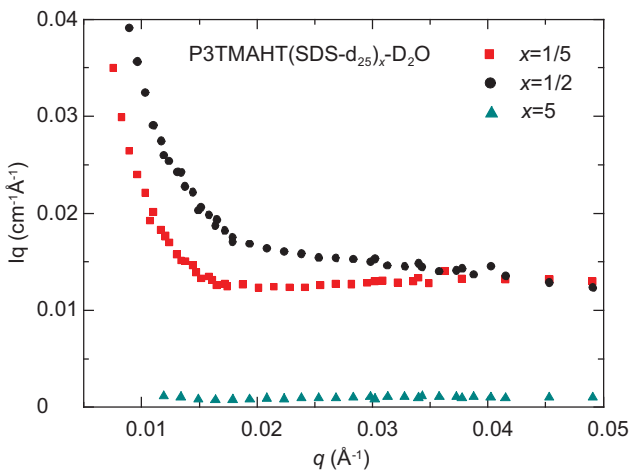


**Figure s2.** Holtzer representation of the SANS data of P3TMAHT(SDS-$d_{25}$)$_x$-$D_2O$ for $x$=1/5 (solid red squares), $x$=1/2 (solid black spheres), and $x$=5 (solid cyan upper triangles). The overall concentration was ~10 mg/mL. $T$=20 $^{o}$C.

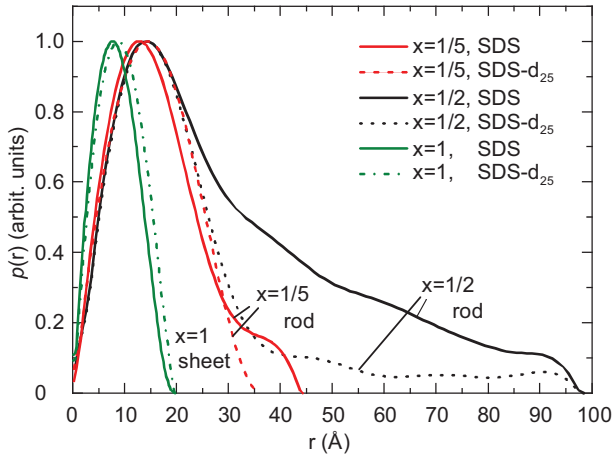


**Figure s3.** Comparison of distance distribution functions as estimated from the SANS data of P3TMAHT(SDS)$_x$-D$_2$O P3TMAHT(SDS-d$_{25}$)$_x$-D$_2$O for $x$=1/5 (solid and dotted red lines) and for $x$=1/2 (solid and dotted black lines) using an elongated rod-like particle model; and for $x$=1 (solid and dotted green line) using a sheet-like particle model. The functions are calculated by Glatter software and correspond to the fits shown in Figs. 3a and 5.

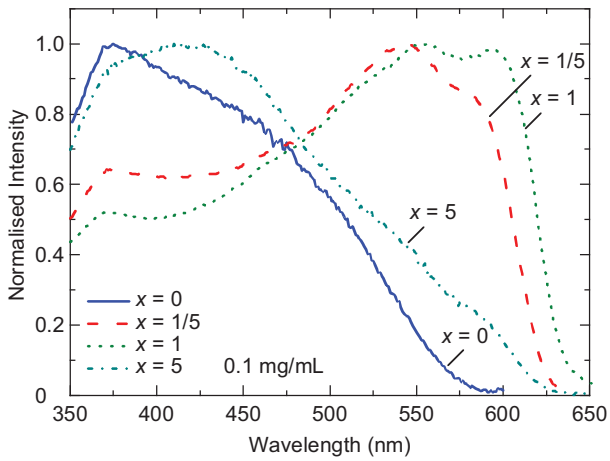


**Figure s4.** Photoexcitation spectra of 0.1 mg/mL P3TMAHT-D$_2$O (solid blue curve) and P3TMAHT(SDS)$_x$-D$_2$O for $x$=1/5 (dashed red curve), $x$=1 (dotted green curve), and $x$=5 (dashed and dotted cyan curve). The overall concentration was ~0.1 mg/ml. in all cases. The data were detected at $\lambda_{em}$ = 680 nm. $T$=20 $^{o}$C.