Electronic Supplementary Material (ESI) for Soft Matter
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Supporting informations

Behavior of wormlike micellar solutions formed without any additives from semi-fluorinated quaternary ammonium salts

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I- Chemical characterizations of the synthesized products

Tertiary Amines ($A_{n,m}$)

$A_{8,1}$

Yield 95 %

spectral data: MS *m/z* (rel. ab. %): 521 ([M]+●, 5 %); 506 ([M-CH3]+, 20 %), 88 ([M-$CF_3(CF_2)_7$, -CH_2]+, 10 %), 58 ([M-$CF_3(CF_2)_8CHOHCH_2$]+, 100 %);

^{1}H NMR (CD_3OD): δ = 2.39 (m, CH_2(a), 2H); 2.6 (m, CH(b), 1H); 2.49 (d, CH_2(c), 2H); 2.29 (t, CH_3(d), 6H); 4.2 (d, OH(e), 1H).

^{19}F NMR (CD_3OD): δ = -80.9 (t, CF_3(a), 3F); -111.7 (m, CF_2CH_2(b), 2F); -126.2 (m, CF_2(c), 2F); -123.3 (m, CF_2(d), 2F);-122.8 (m, CF_2(e), 2F);-121.9 (m, CF_2(f), 2F); -121.6 (m, CF_2(g,h), 4F).

$A_{8,2}$

Yield 84 %

spectral data: MS *m/z* (rel. ab. %): 549 ([M]+●, 3 %), 116 ([M-$CF_3(CF_2)_7$, -CH_2]+, 30 %), 86 ([M-$CF_3(CF_2)_8$CHOHCH_2]+, 100 %, 69 [CF_3]+ 15 %;

^{1}H NMR (CD_3OD): δ = 2.18(m, CH_2(a), 1H); 2.49 (m, CH_2(a), 1H); 4.2 (d-d, CH(b), 1H); 2.49 (m, CH_2(c,d,), 6H); 1.04 (t, CH_3(e), 6H); 4.1 (d-d,OH(f), 1H).

^{19}F NMR (CD_3OD): δ = -80.9 (t, CF_3(a), 3F); -111.7 (m, CF_2CH_2(b), 2F); -126.2 (m, CF_2(c), 2F); -123.3 (m, CF_2(d), 2F);-122.8 (m, CF_2(e), 2F);-121.9 (m, CF_2(f), 2F); -121.6 (m, CF_2(g,h), 4F).

$A_{6,1}$

Yield 94 %

spectral data: MS *m/z* (rel. ab. %): 421 ([M]+●, 5 %); 406 ([M-CH_3]+, 20 %), 88 ([M-$CF_3(CF_2)_7$, -CH_2]+, 100 %), 58 ([M-$CF_3(CF_2)_8$CHOHCH_2]+, 100 %);

^{1}H NMR (CD_3OD): δ = 2.39 (m, CH_2(a), 2H); 2.6 (m, CH(b), 1H); 2.49 (d, CH_2(c), 2H); 2.29 (t, CH_3(d), 6H); 4.2 (d, OH(e), 1H).
^{19}F NMR (CD_3OD): δ = -80.9 (t, CF_3(a), 3F); -111.7 (m, CF_2CH_2(b), 2F); -126.2 (m, CF_2(c), 2F); -123.3 (m, CF_2(d), 2F);-122.8 (m, CF_2(e), 2F);-121.8 (m, CF_2(f), 2F).

$A_{6,2}$

Yield 89 %

spectral data: MS *m/z* (rel. ab. %): 449 ([M]+●, 5 %); 116 ([M-$CF_3(CF_2)_7$, -CH_2]+, 30 %), 86 ([M-$CF_3(CF_2)_8$CHOHCH_2]+, 100 %);

^{1}H NMR (CD_3OD): δ = 2.18 (m, CH_2 (a), 1H); 2.49 (m, CH_2 (a), 1H); 4.2 (d-d, CH(b), 1H); 2.49 (m, CH2(c,d,), 6H); 1.04 (t, CH_3(e), 6H); 4.1 (d-d, OH(f), 1H).

^{19}F NMR (CD_3OD): δ = -80.9 (t, CF_3(a), 3F); -111.7 (m, CF_2CH_2 (b), 2F); -126.2 (m, CF_2(c), 2F); -123.3 (m, CF_2 (d), 2F);-122.8 (m, CF_2 (e), 2F);-121.8 (m, CF_2 (f), 2F).

$A_{4,1}$

Yield 93 %

spectral data: MS *m/z* (rel. ab. %): 321 ([M]+●, 5 %); 306 ([M-CH_3]+, 20 %), 88 ([M-$CF_3(CF_2)_7$, -CH_2]+, 100 %), 58 ([M-$CF_3(CF_2)_8$CHOHCH_2]+, 100 %);
^{1}H NMR (CD_3OD): δ = 2.39 (m, CH_2(a), 2H); 2.6 (m, CH(b), 1H); 2.49 (d, CH_2(c), 2H); 2.29 (t, CH_3(d), 6H); 4.2 (d, OH(e), 1H).
^{19}F NMR (CD_3OD): δ = -80.9 (t, CF_3(a), 3F); -111.7 (m, CF_2CH_2(b), 2F); -126.2 (m, CF_2(c), 2F); -123.3 (m, CF_2(d), 2F);-122.8 (m, CF_2(e), 2F);-121.8 (m, CF_2(f), 2F).

$A_{4,2}$

Yield 80 %

spectral data: MS *m/z* (rel. ab. %): 349 ([M]+●, 10 %), 116 ([M-$CF_3(CF_2)_7$, -CH_2]+, 30 %), 86 ([M-$CF_3(CF_2)_8CH_2OHCH_2$]+, 100 %);

^{1}H NMR (CD_3OD): δ = 2.18 (m, CH_2(a), 1H); 2.49 (m, CH_2(a), 1H); 4.2 (d-d, CH(b), 1H); 2.49 (m, CH_2(c,d,), 6H); 1.04 (t, CH_3(e), 6H); 4.1 (d-d, OH(f), 1H).
^{19}F NMR (CD_3OD): δ = -80.9 (t, CF_3(a), 3F); -111.7 (m, CF_2CH_2(b), 2F); -126.2 (m, CF_2(c), 2F); -123.3 (m, CF_2(d), 2F).

Quaternary ammonium salts (F_nH_m)

F_8H_1

Yield 91 % from $A_{8,1}$

^{1}H NMR (CD_3OD): δ = 2.24 (m, CH_2(a), 2H); 4.6 (m, CH(b), 1H); 3.51 (t, CH_2(c), 2H); 3.26 (m, CH_3(d), 9H); 4.7 (m, OH(e), 1H).
^{19}F NMR (CD_3OD): δ = -80.9 (t, CF_3(a), 3F); -111.7 (m, CF_2CH_2(b), 2F); -126.2 (m, CF_2(c), 2F); -123.3 (m, CF_2(d), 2F).

F_8H_2

Yield 88 % from $A_{8,2}$

^{1}H NMR (CD_3OD): δ = 2.46 (m, CH_2(a), 2H); 4.6 (m, CH(b), 1H); 3.52 (m, CH_2(c,d), 6H); 3.14 (s, CH_3(e), 3H); 4.7 (m, CH(f), 1H); 1.37 (t, CH_3(g), 6H).

^{19}F NMR (CD_3OD): δ = -80.9 (t, CF_3(a), 3F); -111.7 (m, CF_2CH_2(b), 2F); -126.2 (m, CF_2(c), 2F); -123.3 (m, CF_2(d), 2F);-122.8 (m, CF_2(e), 2F);-121.9 (m, CF_2(f), 2F); -121.6 (m, CF_2(g,h), 4F).

F_6H_1

Yield 94 % from $A_{6,1}$

^{1}H NMR (CD_3OD): δ = 2.24 (m, CH_2(a), 2H); 4.6 (m, CH(b), 1H); 3.51 (t, CH_2(c), 2H); 3.26 (m, CH_3(d), 9H); 4.7 (m, OH(e), 1H).
^{19}F NMR (CD_3OD): δ = -80.9 (t, CF_3(a), 3F); -111.7 (m, CF_2CH_2(b), 2F); -126.2 (m, CF_2(c), 2F); -123.3 (m, CF_2(d), 2F);-122.8 (m, CF_2(e), 2F);-121.8 (m, CF_2(f), 2F).

F_6H_2

Yield 89 % from $A_{6,2}$

^{1}H NMR (CD_3OD): δ = 2.46 (m, CH_2(a), 2H); 4.6 (m, CH(b), 1H); 3.52 (m, CH_2(c,d), 6H); 3.14 (s, CH_3(e), 3H); 4.7 (m, CH(f), 1H); 1.37 (t, CH_3(g), 6H).
^{19}F NMR (CD_3OD): δ = -80.9 (t, CF_3(a), 3F); -111.7 (m, CF_2CH_2(b), 2F); -126.2 (m, CF_2(c), 2F); -123.3 (m, CF_2(d), 2F);-122.8 (m, CF_2(e), 2F);-121.8 (m, CF_2(f), 2F).

F_4H_1

Yield 93 % from $A_{4,1}$

^{1}**H NMR** (CD_3OD): δ = 2.24 (m, CH_2(a), 2H); 4.6 (m, CH(b), 1H); 3.51 (t, CH_2(c), 2H); 3.26 (m, CH_3(d), 9H); 4.7 (m, OH(e), 1H).

^{19}**F NMR** (CD_3OD): δ = -80.9 (t, CF_3(a), 3F); -111.7 (m, CF_2CH_2(b), 2F); -126.2 (m, CF_2(c), 2F); -123.3 (m, CF_2(d), 2F).

F_4H_2

Yield 73 % from $A_{4,2}$

^{1}**H NMR** (CD_3OD): δ = 2.46 (m, CH_2(a), 2H); 4.6 (m, CH(b), 1H); 3.52 (m, CH_2(c,d), 6H); 3.14 (s, CH_3(e), 3H); 4.7 (m, CH(f), 1H); 1.37 (t, CH_3(g), 6H).
^{19}**F NMR** (CD_3OD): δ = -80.9 (t, CF_3(a), 3F); -111.7 (m, CF_2CH_2(b), 2F); -126.2 (m, CF_2(c), 2F); -123.3 (m, CF_2(d), 2F).

II- Surfactant properties

The surface tensions of the aqueous solutions of the fluorinated surfactants were measured using a Kruss K100 tensiometer by the Wilhelmy plate technique [N.R. Pallas, B.A. Pethica, Colloids Surf. 36 (1989) 369]. All of the measurements were performed at 25 °C

Table 1 : surface tension at the critical micellar concentration cmc (γ_{cmc}) ***and cmc measured for the synthesized surfactants***

surfactants	γ_{cmc} [mN/m]	cmc [mmol/L]
F_8H_1	15.7	0.840
F_6H_1	16.6	1.280
F_4H_1	19	1.470
F_8H_2	17.5	0.756
F_6H_2	20.2	1.200
F_4H_2	22.9	1.360

III- DLS measurments

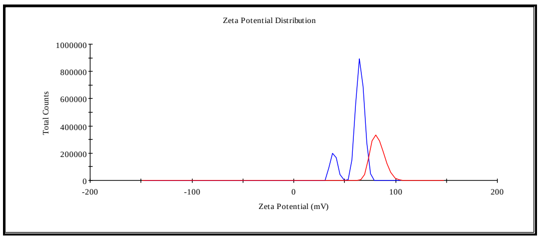

Figure 1. Zeta potential for F_8H_1. Red at C_1=20xcmc, blue F_8H_1 at C_2=30xcmc

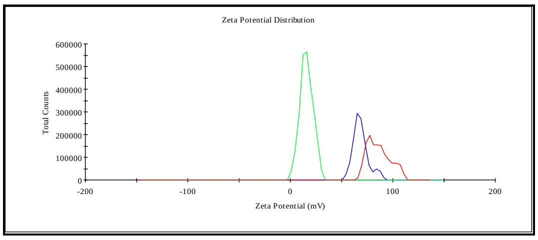

Figure 2. Zeta potential for F_8H_2. Red at C_1=20xcmc, blue F_8H_2 at C_2=30xcmc, green F_8H_2 at C_3=40xcmc.

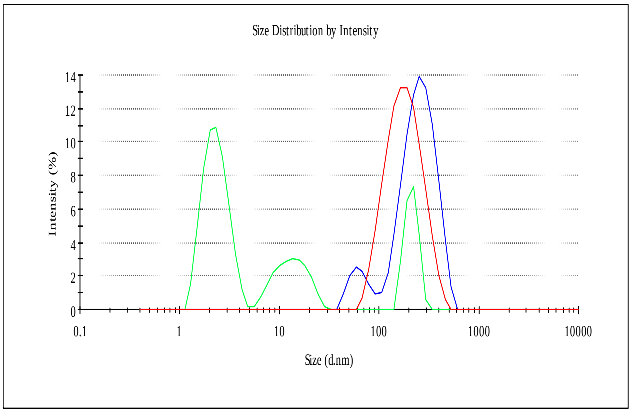

Figure 3. Variation in diameter as a function of fluorinated chain. Blue line for F_8H_1, green line for F_6H_1, red line for F_4H_1.

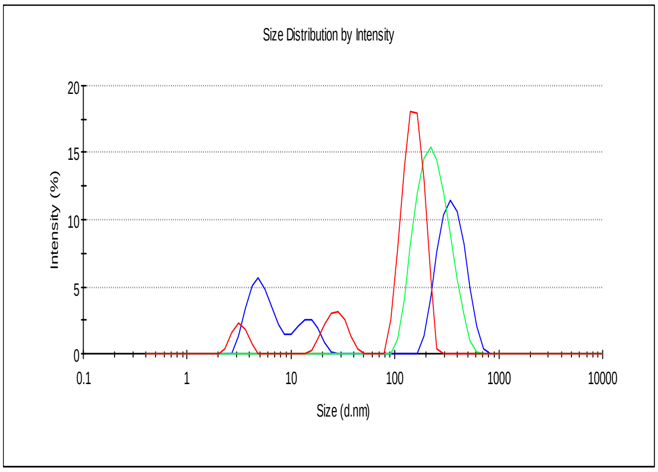

Figure 4. Variation in diameter as function of the fluorinated chain. Blue line for F_8H_2,Red line for F_6H_2, green line for F_4H_2.

IV-Rheological curves

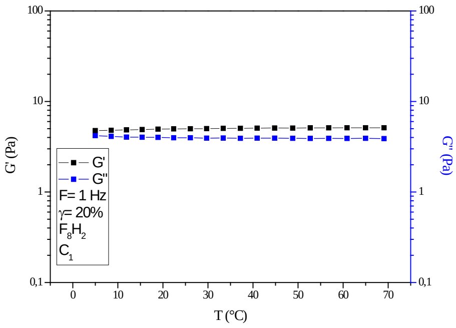

Figure 5. Storage and loss modulus at C_1=20xcmc as function of temperature for F_8H_2

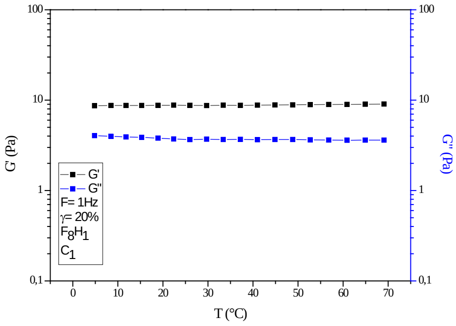

Figure 6. Storage and loss modulus at C_1=20xcmc as function of temperature for F_8H_1.

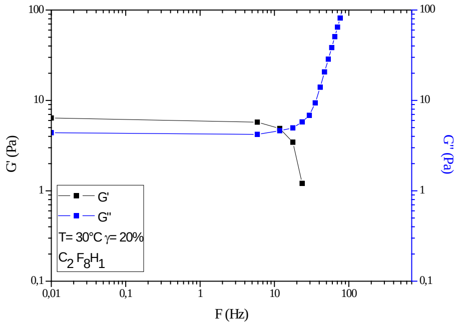

Figure 7. G’ and G” as function of frequency for F_8H_2 at C_2=30xcmc

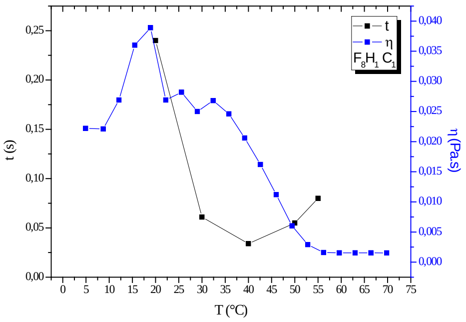

Figure 8. Correlation between viscosity and relaxation time for F_8H_1 at C_2=30xcmc

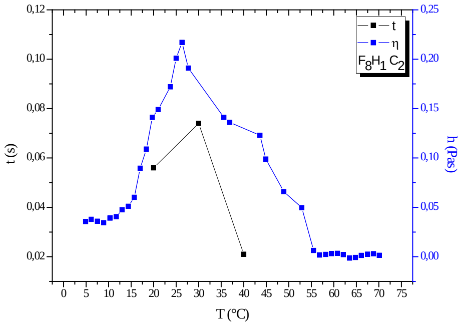

Figure 8. Correlation between viscosity and relaxation time for F_8H_1 at C_1=20xcmc

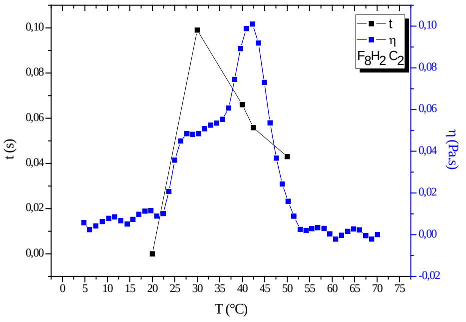

Figure 9. Correlation between viscosity and relaxation time for F_8H_2 at C_2=30xcmc