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Supplementary Information

Characterization and Solution Properties of Quaternary-Ammonium-Salt-Type Amphiphilic Trimeric Ionic Liquids

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S1. Synthesis of Quaternary-Ammonium-Salt-Type Amphiphilic Trimeric Ionic Liquids.

The structure of tris(*N*-alkyl-*N*, *N*-dimethyl-2-ammonioethyl)amine tribromide ($3C_n$tris-2-Q Br), $3C_n$tris-2-Q X, tris(*N*-alkyl-*N*, *N*-dimethyl-3-ammoniopropyl)amine tribromide ($3C_n$tris-3-Q Br), $3C_n$tris-3-Q X, methylalkylbis[3- (dimethylalkylammonio)propyl]ammonium tribromide, ($3C_n$lin-3-Q Br), and $3C_n$lin-3-Q X were determined by ^{1}H NMR (Bruker Ultrashield 300MHz, Billerica, MA, USA), and elemental analysis (Perkin-Elmer 2400II CHNS/O, Waltham, MA, USA).

S1.1. Tris(N-alkyl-N, N-dimethyl-2-ammonioethyl)amine Tribromide ($3C_n$tris-2-Q Br).

The yields were as follows: $3C_8$tris-2-Q I: 38 %, $3C_{10}$tris-2-Q I: 35 %, $3C_{12}$tris-2-Q Br: 36 %, $3C_{14}$tris-2-Q Br: 40 %.

^{1}H NMR ($CDCl_3$, TMS):

$3C_8$tris-2-Q I. δ 0.883 (t, 18H, C*H*$_3$–$(CH_2)_{n-1}$–N^+), 1.27−1.38 (m, 30H, CH_3–(C*H*$_2$)$_5$–CH_2–CH_2–N^+), 1.78 (m, 6H, CH_3–$(CH_2)_5$–C*H*$_2$–CH_2–N^+), 3.40 (s, 18H, –N^+(C*H*$_3$)$_2$), 3.48 (t, 6H, N–C*H*$_2$–CH_2–N^+), 3.64 (t, 6H, CH_3–$(CH_2)_5$–CH_2–C*H*$_2$–N^+), 4.12 ppm (t, 6H, N–CH_3–C*H*$_2$–N^+).

$3C_{10}$tris-2-Q I. δ 0.882 (t, 18H, C*H*$_3$–$(CH_2)_9$–N^+), 1.26−1.38 (m, 3H, CH_3–(C*H*$_2$)$_7$–CH_2–CH_2–N^+), 1.79 (m, 6H, CH_3–$(CH_2)_7$–C*H*$_2$–CH_2–N^+), 3.40 (s, 18H, –N^+(C*H*$_3$)$_2$), 3.48 (t, 6H, N–C*H*$_2$–CH_2–N^+), 3.64 (t, 6H, CH_3–$(CH_2)_7$–CH_2–C*H*$_2$–N^+), 4.13 ppm (t, 6H, N–CH_3–C*H*$_2$–N^+).

$3C_{12}$tris-2-Q Br. δ 0.882 (t, 18H, C*H*$_3$–$(CH_2)_{11}$–N^+), 1.25−1.38 (m, 3H, CH_3–(C*H*$_2$)$_9$–CH_2–CH_2–N^+), 1.75 (m, 6H, CH_3–$(CH_2)_9$–C*H*$_2$–CH_2–N^+), 3.44 (s, 18H, –N^+(C*H*$_3$)$_2$), 3.48 (t, 6H, N–C*H*$_2$–CH_2–N^+), 3.62 (t, 6H, CH_3–$(CH_2)_9$–CH_2–C*H*$_2$–N^+), 4.06 ppm (t, 6H, N–CH_3–C*H*$_2$–N^+).

$3C_{14}$tris-2-Q Br. δ 0.881 (t, 18H, C*H*$_3$–$(CH_2)_{13}$–N^+), 1.25−1.37 (m, 3H, CH_3–(C*H*$_2$)$_{11}$–CH_2–CH_2–N^+), 1.75 (m, 6H, CH_3–$(CH_2)_{11}$–C*H*$_2$–CH_2–N^+), 3.37 (s, 18H, –N^+(C*H*$_3$)$_2$), 3.43 (t, 6H, N–C*H*$_2$–CH_2–N^+), 3.66 (t, 6H, CH_3–$(CH_2)_{11}$–CH_2–C*H*$_2$–N^+), 4.14 ppm (m, 6H, N–CH_3–C*H*$_2$–N^+).

Elemental analysis:

$3C_8$tris-2-Q I. Calcd. for $C_{38}H_{81}N_4I_3$: C, 38.33; H, 8.42; N, 7.55. Found : C, 38.68; H, 9.78; N, 7.64.

$3C_{10}$tris-2-Q I. Calcd. for $C_{42}H_{93}N_4I_3$: C, 48.74; H, 9.06; N, 5.41. Found : C, 48.65; H, 9.24; N, 5.81.

$3C_{12}$tris-2-Q Br. Calcd. for $C_{48}H_{105}N_4Br_3$: C, 58.94; H, 10.82; N, 5.73. Found : C, 58.35; H, 11.03; N, 5.70.

$3C_{14}$tris-2-Q Br. Calcd. for $C_{54}H_{117}N_4Br_3 \cdot 2H_2O$: C, 59.05; H, 11.11; N, 5.10. Found : C, 59.04; H, 11.33; N, 5.44.

S1. 2. Tris(N-alkyl-N, N-dimethyl-3-ammoniopropyl)amine Tribromide ($3C_n$tris-3-Q Br).

The yields were as follows: $3C_8$tris-3-Q Br: 48 %, $3C_{10}$tris-3-Q Br: 92 %, $3C_{12}$tris-3-Q Br: 86 %, $3C_{14}$tris-3-Q Br: 86 %.

^{1}H NMR ($CDCl_3$, TMS):

$3C_8$tris-3-Q Br. δ 0.878 (t, 9H, C*H*$_3$–$(CH_2)_{11}$–N^+), 1.27−1.36 (m, 30H, CH_3–(C*H*$_2$)$_9$–CH_2–CH_2–N^+), 1.75

(m, 6H, CH_3–$(CH_2)_7$–CH_2–CH_2–N^+), 2.29 (m 6H, N–CH_2–CH_2–CH_2–N^+), 2.86 (t, 6H, N–CH_2–CH_2–CH_2–N^+), 3.34 (s, 18H, –N^+(CH_3)$_2$), 3.54 (t, 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 4.07 ppm (t, 6H, N–CH_2–CH_2–CH_2–N^+).

$3C_{10}$tris-3-Q Br. δ 0.880 (t, 9H, CH_3–$(CH_2)_{11}$–N^+), 1.26−1.36 (m, 42H, CH_3–(CH_2)$_9$–CH_2–CH_2–N^+), 1.75 (m, 6H, CH_3–$(CH_2)_7$–CH_2–CH_2–N^+), 2.28 (m 6H, N–CH_2–CH_2–CH_2–N^+), 2.88 (t, 6H, N–CH_2–CH_2–CH_2–N^+), 3.35 (s, 18H, –N^+(CH_3)$_2$), 3.53 (t, 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 4.08 ppm (t, 6H, N–CH_2–CH_2–CH_2–N^+).

$3C_{12}$tris-3-Q Br. δ 0.880 (t, 9H, CH_3–$(CH_2)_{11}$–N^+), 1.26−1.36 (m, 54H, CH_3–(CH_2)$_9$–CH_2–CH_2–N^+), 1.74 (m, 6H, CH_3–$(CH_2)_7$–CH_2–CH_2–N^+), 2.18 (m 6H, N–CH_2–CH_2–CH_2–N^+), 2.72 (t, 6H, N–CH_2–CH_2–CH_2–N^+), 3.34 (s, 18H, –N^+(CH_3)$_2$), 3.54 (t, 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 4.06 ppm (t, 6H, N–CH_2–CH_2–CH_2–N^+).

$3C_{14}$tris-3-Q Br. δ 0.880 (t, 9H, CH_3–$(CH_2)_{11}$–N^+), 1.25−1.36 (m, 66H, CH_3–(CH_2)$_9$–CH_2–CH_2–N^+), 1.60 (m, 6H, CH_3–$(CH_2)_7$–CH_2–CH_2–N^+), 2.22 (m 6H, N–CH_2–CH_2–CH_2–N^+), 2.78 (t, 6H, N–CH_2–CH_2–CH_2–N^+), 3.34 (s, 18H, –N^+(CH_3)$_2$), 3.54 (t, 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 4.07 ppm (t, 6H, N–CH_2–CH_2–CH_2–N^+).

Elemental analysis:

$3C_8$tris-3-Q Br. Calcd. for $C_{39}H_{87}N_4Br_3\cdot 3H_2O$: C, 51.71; H, 10.35; N, 6.18. Found : C, 51.82; H, 11.14; N, 6.19. $3C_{10}$tris-3-Q Br. Calcd. for $C_{45}H_{99}N_4Br_3\cdot 2H_2O$: C, 55.60; H, 10.68; N, 5.76. Found : C, 55.31; H, 11.35; N, 5.78. $3C_{12}$tris-3-Q Br. Calcd. for $C_{51}H_{111}N_4Br_3\cdot 2H_2O$: C, 58.00; H, 10.97; N, 5.30. Found : C, 57.85; H, 11.56; N, 5.30. $3C_{14}$tris-3-Q Br. Calcd. for $C_{57}H_{123}N_4Br_3\cdot 2H_2O$: C, 60.03; H, 11.23; N, 4.91. Found : C, 60.05; H, 11.78; N, 4.94.

S1. 3. Methylalkylbis[3-(dimethylalkylammonio)propyl]ammonium Tribromide ($3C_n$lin-3-Q Br).

The yields were as follows: $3C_8$lin-3-Q Br: 86 %, $3C_{10}$lin-3-Q Br: 94 %, $3C_{12}$lin-3-Q Br: 70 %, $3C_{14}$lin-3-Q Br: 93 %.^{1}H NMR ($CDCl_3$, TMS):

$3C_8$lin-3-Q Br. δ 0.882 (t, 9H, CH_3–$(CH_2)_{13}$–N^+), 1.26−1.33 (m, 30H, CH_3–(CH_2)$_5$–CH_2–CH_2–N^+), 1.80 (m, 6H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 2.63 (m, 4H, N^+−CH_2−CH_2−CH_2−N^+), 3.42 (s, 15H, –N^+(CH_3)$_2$, $(CH_3)_2N^+$−$(CH_2)_3$–N^+−CH_3), 3.49 (m, 6H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 3.92 ppm (m, 8H, N^+–CH_2–CH_2−CH_2–N^+).

$3C_{10}$lin-3-Q Br. δ 0.879 (t, 9H, CH_3–$(CH_2)_{13}$–N^+), 1.26−1.36 (m, 42H, CH_3–(CH_2)$_7$–CH_2–CH_2–N^+), 1.81 (m, 6H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 2.69 (m, 4H, N^+−CH_2−CH_2−CH_2−N^+), 3.42 (s, 15H, –N^+(CH_3)$_2$, $(CH_3)_2N^+$−$(CH_2)_3$–N^+−CH_3), 3.51 (m, 6H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 3.87 ppm (m, 8H, N^+–CH_2–CH_2−CH_2–N^+).

$3C_{12}$lin-3-Q Br. δ 0.883 (t, 9H, CH_3–$(CH_2)_{13}$–N^+), 1.26−1.36 (m, 54H, CH_3–(CH_2)$_9$–CH_2–CH_2–N^+), 1.80 (m, 6H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 2.78 (m, 4H, N^+−CH_2−CH_2−CH_2−N^+), 3.41 (s, 15H, –N^+(CH_3)$_2$,

$(CH_3)_2N^+$–$(CH_2)_3$–N^+–CH_3), 3.51 (m, 6H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 3.91 ppm (m, 8H, N^+–CH_2–CH_2–CH_2–N^+).

$3C_{14}$lin-3-Q Br. δ 0.881 (t, 9H, CH_3–$(CH_2)_{13}$–N^+), 1.26−1.35 (m, 66H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 1.80 (m, 6H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 2.79 (m, 4H, N^+–CH_2–CH_2–CH_2–N^+), 3.44 (s, 15H, –$N^+(CH_3)_2$, $(CH_3)_2N^+$–$(CH_2)_3$–N^+–CH_3), 3.48 (m, 6H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 3.91 ppm (m, 8H, N^+–CH_2–CH_2–CH_2–N^+).

Elemental analysis:

$3C_8$lin-3-Q Br. Calcd. for $C_{35}H_{78}N_3Br_3$: C, 53.84; H, 10.07; N, 5.38. Found : C, 53.77; H, 10.58; N, 5.39.

$3C_{10}$lin-3-Q Br. Calcd. for $C_{41}H_{90}N_3Br_3$: C, 56.94; H, 10.49; N, 4.86. Found : C, 56.40; H, 10.82; N, 4.90.

$3C_{12}$lin-3-Q Br. Calcd. for $C_{47}H_{102}N_3Br_3 \cdot H_2O$: C, 58.37; H, 10.84; N, 4.35. Found : C, 58.08; H, 11.23; N, 4.35.

S1. 4. Tris(N-alkyl-N, N-dimethyl-2-ammoniomethyl)amine Bis(trifluoromethanesulfonyl)amide ($3C_n$tris-2-Q NTf_2).

The yields were as follows: $3C_8$tris-2-Q NTf_2: 56 %, $3C_{10}$tris-2-Q NTf_2: 92 %, $3C_{12}$tris-2-Q NTf_2: 83 %, $3C_{14}$tris-2-Q NTf_2: 97 %.

^{1}H NMR ($CDCl_3$, TMS):

$3C_8$ tris-2-Q NTf_2. δ 0.878 (t, 9H, CH_3–$(CH_2)_7$–N^+), 1.26−1.33 (m, 30H, CH_3–$(CH_2)_5$–CH_2–CH_2–N^+), 1.72 (m, 6H, CH_3–$(CH_2)_5$–CH_2–CH_2–N^+), 3.08 (s, 18H, –$N^+(CH_3)_2$), 3.13 (t, 6H, N–CH_2–CH_2–N^+), 3.27−3.32 (m 6H, CH_3–$(CH_2)_5$–CH_2–CH_2–N^+), 3.52 ppm (t, 6H, N–CH_3–CH_2–N^+).

$3C_{10}$tris-2-Q NTf_2. δ 0.878 (t, 9H, CH_3–$(CH_2)_9$–N^+), 1.26−1.33 (m, 42H, CH_3–$(CH_2)_7$–CH_2–CH_2–N^+), 1.72 (m, 6H, CH_3–$(CH_2)_7$–CH_2–CH_2–N^+), 3.07 (s, 18H, –$N^+(CH_3)_2$), 3.14 (t, 6H, N–CH_2–CH_2–N^+), 3.27−3.30 (m 6H, CH_3–$(CH_2)_7$–CH_2–CH_2–N^+), 3.56 ppm (t, 6H, N–CH_3–CH_2–N^+).

$3C_{12}$tris-2-Q NTf_2. δ 0.878 (t, 9H, CH_3–$(CH_2)_{11}$–N^+), 1.25−1.33 (m, 54H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 1.72 (m, 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 3.08 (s, 18H, –$N^+(CH_3)_2$), 3.13 (t, 6H, N–CH_2–CH_2–N^+), 3.26−3.30 (m 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 3.53 ppm (t, 6H, N–CH_3–CH_2–N^+).

$3C_{14}$tris-2-Q NTf_2. δ 0.878 (t, 9H, CH_3–$(CH_2)_{13}$–N^+), 1.25−1.33 (m, 66H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 1.72 (m, 6H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 3.09 (s, 18H, –$N^+(CH_3)_2$), 3.13 (t, 6H, N–CH_2–CH_2–N^+), 3.27−3.33 (m 6H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 3.57 ppm (t, 6H, N–CH_3–CH_2–N^+).

Elemental analysis:

$3C_8$tris-2-Q NTf_2. Calcd. for $C_{42}H_{81}N_7O_{12}F_{18}S_6$: C, 35.76; H, 5.79; N, 6.95. Found : C, 35.66; H, 5.75; N, 6.91.

$3C_8$tris-2-Q NTf_2. Calcd. for $C_{42}H_{81}N_7F_{18}O_{12}S_6$: C, 35.76; H, 5.79; N, 6.95. Found : C, 35.66; H, 5.75; N, 6.91.

$3C_{10}$tris-2-Q NTf_2. Calcd. for $C_{48}H_{93}N_7F_{12}O_{18}S_6$: C, 38.57; H, 6.27; N, 6.56. Found : C, 39.10; H, 6.81; N,

6.58.

$3C_{12}$tris-2-Q NTf_2. Calcd. for $C_{54}H_{105}N_7F_{18}O_{12}S_6$: C, 41.08; H, 6.70; N, 6.21. Found : C, 41.29; H, 7.46; N, 6.25.

$3C_{14}$tris-2-Q NTf_2. Calcd. for $C_{60}H_{117}N_7F_{18}O_{12}S_6$: C, 43.57; H, 7.92; N, 6.59. Found : C, 43.73; H, 8.01; N, 6.62.

S1. 5. Tris(N-alkyl-N, N-dimethyl-3-ammoniopropyl)amine X [X : Trifluoromethanesulfonate, Bis(trifluoromethanesulfonyl)amide, Bis(fluorosulfonyl)amide, Bis(trifluoromethanesulfonyl)amide] ($3C_n$tris-3-Q X, X = PF_6, OTf, FSA, NTf_2).

The yields were as follows: $3C_{12}$tris-3-Q PF_6: 58 %, $3C_{12}$tris-3-Q OTf: 73 %, $3C_{12}$tris-3-Q FSA: 87 %. $3C_8$tris-3-Q NTf_2: 90 %, $3C_{10}$tris-3-Q NTf_2: 92 %, $3C_{12}$tris-3-Q NTf_2: 87 %, $3C_{14}$tris-3-Q NTf_2: 93 %.

^{1}H NMR ($CDCl_3$, TMS):

$3C_{12}$tris-3-Q PF_6. δ 0.872 (t, 9H, CH_3–$(CH_2)_{11}$–N^+), 1.25−1.34 (m, 54H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 1.73. (m, 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 2.07 (m 6H, N–CH_2–CH_2–CH_2–N^+), 2.70 (t, 6H, N–CH_2–CH_2–CH_2–N^+), 3.06 (s, 18H, –$N^+(CH_3)_2$), 3.26−3.30 (m, 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 3.52−3.53 ppm (m, 6H, N–CH_2–CH_2–CH_2–N^+).

$3C_{12}$tris-3-Q OTf. δ 0.880 (t, 9H, CH_3–$(CH_2)_{11}$–N^+), 1.25−1.33 (m, 54H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 1.71 (m, 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 2.11 (m 6H, N–CH_2–CH_2–CH_2–N^+), 2.69 (t, 6H, N–CH_2–CH_2–CH_2–N^+), 3.13 (s, 18H, –$N^+(CH_3)_2$), 3.30−3.36 (m, 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 3.57−3.63 ppm (m, 6H, N–CH_2–CH_2–CH_2–N^+).

$3C_{12}$tris-3-Q FSA. δ 0.880 (t, 9H, CH_3–$(CH_2)_{11}$–N^+), 1.26−1.36 (m, 54H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 1.73. (m, 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 2.01 (m 6H, N–CH_2–CH_2–CH_2–N^+), 2.67 (t, 6H, N–CH_2–CH_2–CH_2–N^+), 3.06 (s, 18H, –$N^+(CH_3)_2$), 3.23−3.28 (m, 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 3.35−3.41 ppm (m, 6H, N–CH_2–CH_2–CH_2–N^+).

$3C_8$tris-3-Q NTf_2. δ 0.879 (t, 9H, CH_3–$(CH_2)_7$–N^+), 1.27−1.34 (m, 30H, CH_3–$(CH_2)_5$–CH_2–CH_2–N^+), 1.72 (m, 6H, CH_3–$(CH_2)_5$–CH_2–CH_2–N^+), 2.23 (m 6H, N–CH_2–CH_2–CH_2–N^+), 3.07 (s, 18H, –$N^+(CH_3)_2$), 3.26 (t, 6H, CH_3–$(CH_2)_5$–CH_2–CH_2–N^+), 3.44 ppm (t, 12H, N–CH_2–CH_2–CH_2–N^+).

$3C_{10}$tris-3-Q NTf_2. δ 0.879 (t, 9H, CH_3–$(CH_2)_9$–N^+), 1.26−1.34 (m, 42H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 1.71 (m, 6H, CH_3–$(CH_2)_7$–CH_2–CH_2–N^+), 2.06 (m 6H, N–CH_2–CH_2–CH_2–N^+), 3.07 (s, 18H, –$N^+(CH_3)_2$), 3.28 (t, 6H, CH_3–$(CH_2)_7$–CH_2–CH_2–N^+), 3.41 ppm (t, 12H, N–CH_2–CH_2–CH_2–N^+).

$3C_{12}$tris-3-Q NTf_2. δ 0.878 (t, 9H, CH_3–$(CH_2)_{11}$–N^+), 1.26−1.33 (m, 54H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 1.72 (m, 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 2.37 (m 6H, N–CH_2–CH_2–CH_2–N^+), 3.07 (s, 18H, –$N^+(CH_3)_2$), 3.26 (t, 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 3.46 ppm (t, 12H, N–CH_2–CH_2–CH_2–N^+).

$3C_{14}$tris-3-Q NTf_2. δ 0.878 (t, 9H, CH_3–$(CH_2)_{13}$–N^+), 1.25−1.34 (m, 66H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 1.71 (m, 6H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 2.17 (m 6H, N–CH_2–CH_2–CH_2–N^+), 2.96 (m 6H, N–CH_2–CH_2–

CH_2–N^+), 3.06 (s, 18H, –N^+(CH_3)$_2$), 3.26 (t, 6H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 3.43 ppm (t, 6H, N–CH_2–CH_2–CH_2–N^+).

Elemental analysis:

$3C_{12}$tris-3-Q PF_6. Calcd. for $C_{51}H_{111}N_4F_{18}P_3$: C, 50.40; H, 9.21; N, 4.61. Found : C, 50.71; H, 9.48; N, 4.73.

$3C_{12}$tris-3-Q OTf. Calcd. for $C_{54}H_{111}N_4F_9O_9S_3$: C, 52.83; H, 9.11; N, 4.56. Found : C, 52.26; H, 9.40; N, 4.57. $3C_{12}$tris-3-Q FSA. Calcd. for $C_{51}H_{111}N_7F_6O_{12}S_6$: C, 46.38; H, 8.47; N, 7.42. Found : C, 46.12; H, 10.02; N,7.55.

$3C_8$tris-3-Q NTf_2. Calcd. for $C_{45}H_{87}N_7F_{18}O_{12}S_6$: C, 37.21; H, 6.04; N, 6.75. Found : C, 37.44; H, 6.23; N, 6.60. $3C_{10}$tris-3-Q NTf_2. Calcd. for $C_{51}H_{99}N_7F_{18}O_{12}S_6$: C, 39.86; H, 6.49; N, 6.38. Found : C, 39.20; H, 6.44; N, 6.45. $3C_{12}$tris-3-Q NTf_2. Calcd. for $C_{57}H_{111}N_7F_{18}O_{12}S_6$: C, 42.24; H, 6.90; N, 6.05. Found : C, 42.05; H, 7.09; N, 6.12. $3C_{14}$tris-3-Q NTf_2. Calcd. for $C_{63}H_{123}N_7F_{18}O_{12}S_6 \cdot H_2O$: C, 43.46; H, 7.35; N, 5.63. Found : C, 42.58; H, 7.52; N, 5.76.

S1. 6. Methylalkylbis[3-(dimethylalkylammonio)propyl]ammonium bis(trifluoromethanesulfonyl)amide ($3C_n$lin-3-Q NTf_2).

The yields were as follows: $3C_8$lin-3-Q NTf_2: 90 %, $3C_{10}$lin-3-Q NTf_2: 95 %, $3C_{12}$lin-3-Q NTf_2: 89 %, $3C_{14}$lin-3-Q NTf_2: 93 %.

^{1}H NMR ($CDCl_3$, TMS):

$3C_8$lin-3-Q NTf_2. δ 0.859 (t, 9H, CH_3–$(CH_2)_7$–N^+), 1.26−1.34 (m, 30H, CH_3–$(CH_2)_5$–CH_2–CH_2–N^+), 1.74 (m, 6H, CH_3–$(CH_2)_5$–CH_2–CH_2–N^+), 2.35 (m, 4H, N^+−CH_2−CH_2−CH_2−N^+), 3.11 (s, 12H, –N^+(CH_3)$_2$), 3.27 (s, 3H, $(CH_3)_2N^+$−$(CH_2)_3$– N^+−CH_3), 3.35 (m, 6H, CH_3–$(CH_2)_5$–CH_2–CH_2–N^+), 3.48 ppm (t, 8H, N^+–CH_2–CH_2−CH_2–N^+).

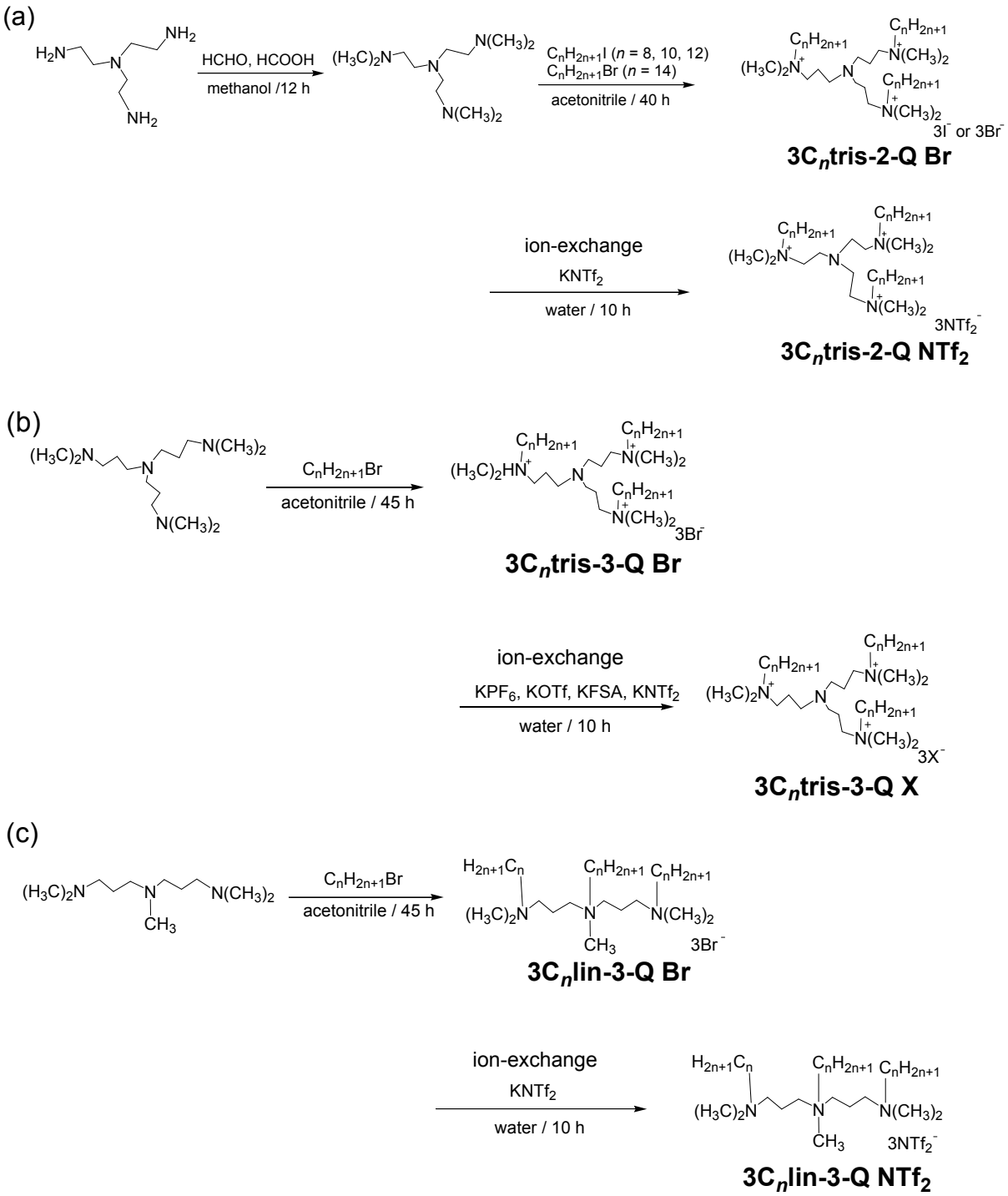
$3C_{10}$lin-3-Q NTf_2. δ 0.880 (t, 9H, CH_3–$(CH_2)_9$–N^+), 1.26−1.32 (m, 42H, CH_3–$(CH_2)_7$–CH_2–CH_2–N^+), 1.70 (m, 6H, CH_3–$(CH_2)_7$–CH_2–CH_2–N^+), 2.50 (m, 4H, N^+−CH_2−CH_2−CH_2−N^+), 3.40 (s, 12H, –N^+(CH_3)$_2$), 3.48 (s, 3H, $(CH_3)_2N^+$−$(CH_2)_3$– N^+−CH_3), 3.37 (m, 6H, CH_3–$(CH_2)_7$–CH_2–CH_2–N^+), 3.72 ppm (m, 8H, N^+–CH_2–CH_2−CH_2–N^+).

$3C_{12}$lin-3-Q NTf_2. δ 0.882 (t, 9H, CH_3–$(CH_2)_{11}$–N^+), 1.26−1.35 (m, 54H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 1.72 (m, 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 2.61 (m, 4H, N^+−CH_2−CH_2−CH_2−N^+), 3.40 (s, 12H, –N^+(CH_3)$_2$), 3.48 (s, 3H, $(CH_3)_2N^+$−$(CH_2)_3$– N^+−CH_3), 3.48 (m, 6H, CH_3–$(CH_2)_9$–CH_2–CH_2–N^+), 3.93 ppm (t, 8H, N^+–CH_2–CH_2−CH_2–N^+).

$3C_{14}$lin-3-Q NTf_2. δ 0.879 (t, 9H, CH_3–$(CH_2)_{13}$–N^+), 1.26−1.33 (m, 66H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 1.72 (m, 6H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 2.62 (m, 4H, N^+−CH_2−CH_2−CH_2−N^+), 3.41 (s, 12H, –N^+(CH_3)$_2$), 3.48 (s, 3H, $(CH_3)_2N^+$−$(CH_2)_3$– N^+−CH_3), 3.48 (m, 6H, CH_3–$(CH_2)_{11}$–CH_2–CH_2–N^+), 3.94 ppm (m, 8H, N^+–CH_2–CH_2−CH_2–N^+).

Elemental analysis:

$3C_8$lin-3-Q NTf_2. Calcd. for $C_{41}H_{78}N_6F_{18}O_{12}S_6$: C, 35.65; H, 5.69; N, 6.08. Found : C, 35.77; H, 5.87; N, 6.22. $3C_{10}$lin-3-Q NTf_2. Calcd. for $C_{47}H_{90}N_6F_{18}O_{12}S_6$: C, 38.52; H, 6.19; N, 5.73. Found : C, 38.94; H, 6.25; N, 5.79. $3C_{12}$lin-3-Q NTf_2. Calcd. for $C_{53}H_{102}N_6F_{18}O_{12}S_6$: C, 41.08; H, 6.63; N, 5.42. Found : C, 41.80; H, 6.82; N, 5.45. $3C_{14}$lin-3-Q NTf_2. Calcd. for $C_{59}H_{114}N_6F_{18}O_{12}S_6$: C, 43.37; H, 7.03; N, 5.14. Found : C, 43.89; H, 7.41; N, 5.21.



Scheme S1 Synthetic schemes of quaternary ammonium salt-type trimeric amphiphilic compounds: (a) 3C$_n$tris-2-Q NTf$_2$, (b) 3C$_n$tris-3-Q X, and (c) 3C$_n$lin-3-Q NTf$_2$.

S2. Melting point.

Table S1 Values of melting point obtained from DSC for amphiphilic compounds $3C_n$tris-*s*-Q X and

Compound	n = 8	10	12	14
$3C_n$tris-2-Q NTf_2	4.4	50.1	48.6	31.3
$3C_n$tris-3-Q PF_6			85.5	
$3C_n$tris-3-Q OTf			161.6	
$3C_n$tris-3-Q FSA			28.5	
$3C_n$tris-3-Q NTf_2	–0.7	0.6	–3.8	−9.1
$3C_n$lin-3-Q NTf_2	–19.9	−5.2	46.6	62.3

$3C_n$lin-*s*-Q NTf_2.