Electronic Supplementary Information

Aescin - a natural soap for the formation of lipid nanodiscs with tunable size

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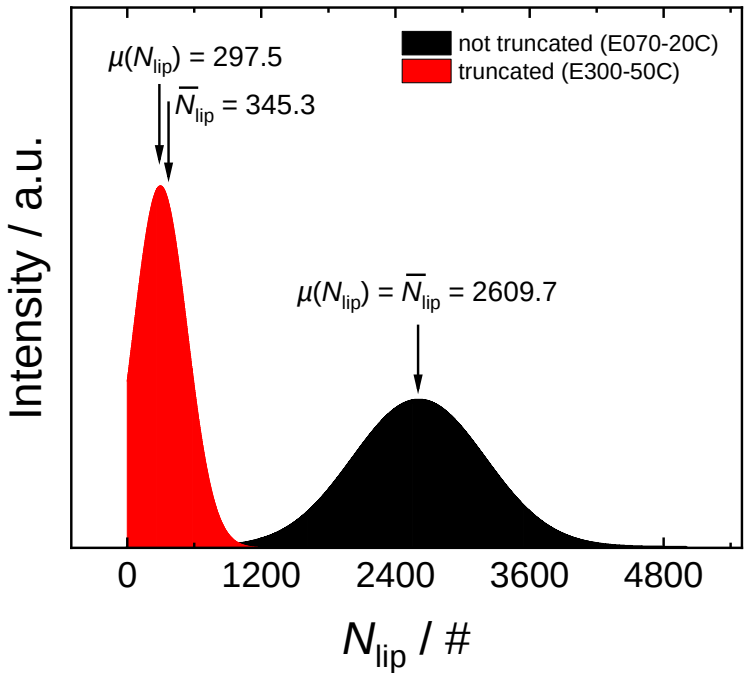

Fig. S1 Exemplary distributions of the number of lipids N_{lip}. The red curve illustrates a normal distribution truncated at zero. The black curve indicates a not-truncated normal distribution. The mean number of lipids ($\overline{N}_{\mathrm{lip}}$) varies from the maximum of the normal distribution $\mu_{N(\mathrm{lip})}$ in a truncated distribution.

Table S1 Parameters of the *polydisperse disc* model. χ^2: goodness of fit; w_{rim}: width of rim; $A_{\text{PC head}}$: area per lipid headgroup; h_{rim}: height of rim; $\mu_{N_{\text{lip}}}$: peak maximum of the distribution of the number of lipids; $\sigma(N_{\text{lip}})$: mean deviation of $N(\text{lip})$; $N(\text{water/PC head})$: number of water molecules per lipid head group; V_m: partial molar volume; BackX: background; ScaleX: scale; $\Delta\rho_{\text{heads}}$: excess scattering length densities of DMPC head groups; $\Delta\rho_{\text{alkyl}}$: excess scattering length densities of DMPC alkyl chains; $\Delta\rho_{\text{me}}$: excess scattering length densities of DMPC methyl groups; $\Delta\rho_{\text{rim}}$: excess scattering length densities of β-aescin rim; h_{bl}: height of bilayer; h_{al}: height of alkyl layer (CH_2 groups); h_{me}: height of methyl layer; $\overline{N}_{\text{lip}}$: mean number of lipids; r_{core} for $\overline{N}_{\text{lip}}$: radius of lipid bilayer (without rim) derived from the mean number of lipids.

	χ^2	w_{rim}	$A_{\text{PC head}}$	h_{rim}	$\mu_{N(\text{lip})}$	$\sigma(N(\text{lip}))$
	-	Å	Å^2	Å	#	#
E070-10C	30.6	18.76 ± 18.40	46.28 ± 3.17	15.47 ± 19.45	3035.2 ± 267.6	702.0 ± 10.1
E070-15C	31.7	18.75 ± 20.60	46.45 ± 3.23	15.32 ± 21.93	3105.9 ± 331.3	735.5 ± 14.0
E070-20C	56.0	11.71 ± 17.43	47.69 ± 4.07	23.43 ± 9.39	2609.7 ± 202.8	585.9 ± 8.4
E100-10C	0.9	14.96 ± 8.42	47.62 ± 2.52	28.10 ± 19.21	1637.2 ± 364.2	396.0 ± 61.7
E100-15C	0.9	14.40 ± 8.08	48.13 ± 2.73	27.51 ± 17.95	1669.1 ± 364.5	413.1 ± 59.2
E100-20C	5.6	12.67 ± 7.40	49.10 ± 2.71	28.32 ± 18.41	1558.7 ± 288.7	391.2 ± 43.4
E100-25C	6.7	7.77 ± 11.82	52.53 ± 3.68	28.26 ± 15.70	3104.7 ± 975.3	988.2 ± 150.6
E100-30C	7.0	4.62 ± 25.68	54.05 ± 4.90	26.86 ± 12.56	9339.7 ± 2758.7	3229.7 ± 401.7
E100-35C	4.3	5.69 ± 28.72	56.91 ± 11.4	24.77 ± 15.05	11566.5 ± 2941.1	2992.3 ± 512.6
E100-40C	12.8	5.63 ± 21.44	55.22 ± 9.79	20.44 ± 7.29	14103.0 ± 2469.2	4283.1 ± 270.4
E100-45C	7.8	6.61 ± 18.15	57.14 ± 12.0	22.99 ± 14.83	14403.1 ± 3276.5	3978.1 ± 425.9
E100-50C	22.4	6.36 ± 13.42	56.75 ± 9.97	20.00 ± 7.40	13299.3 ± 2549.0	3964.5 ± 320.7
E150-10C	1.9	16.30 ± 5.20	46.99 ± 2.32	28.49 ± 13.30	953.3 ± 211.3	248.0 ± 32.4
E150-15C	1.2	15.33 ± 5.73	47.51 ± 2.35	28.88 ± 15.69	1009.4 ± 221.5	280.2 ± 31.0
E150-20C	1.5	13.81 ± 6.84	48.75 ± 2.89	29.02 ± 19.37	971.1 ± 198.8	280.3 ± 25.7
E150-25C	2.4	13.21 ± 4.54	51.37 ± 2.88	25.42 ± 11.27	1233.7 ± 302.0	362.6 ± 43.5
E150-30C	3.7	11.57 ± 9.57	55.99 ± 6.29	26.08 ± 25.97	3168.1 ± 1066.8	1085.4 ± 212.0
E150-35C	3.4	13.00 ± 6.30	55.76 ± 7.26	20.72 ± 10.27	5618.9 ± 2382.2	1828.4 ± 409.0
E150-40C	2.1	11.23 ± 5.96	57.98 ± 13.37	21.46 ± 12.55	10910.6 ± 6696.2	3491.4 ± 1487.9
E150-45C	1.9	11.72 ± 5.61	60.44 ± 18.75	21.35 ± 13.52	12216.5 ± 7884.5	3920.3 ± 1763.8
E150-50C	1.5	11.65 ± 8.98	62.57 ± 18.09	23.7 ± 34.08	8924.8 ± 5210.9	4890.8 ± 1882.2
E200-10C	0.5	32.99 ± 9.40	48.26 ± 3.69	17.78 ± 5.27	458.8 ± 166.7	146.6 ± 22.2
E200-15C	1.0	30.40 ± 10.57	48.04 ± 3.92	17.05 ± 13.7	491.6 ± 185.3	162.0 ± 35.3
E200-20C	1.2	16.59 ± 4.25	48.65 ± 2.49	30.37 ± 13.4	593.5 ± 144.5	200.5 ± 21.1
E200-25C	2.4	29.56 ± 9.08	51.17 ± 3.09	15.46 ± 19.3	510.8 ± 169.3	169.4 ± 30.3
E200-30C	4.6	28.07 ± 11.31	54.75 ± 3.72	13.68 ± 3.24	974.7 ± 305.8	322.6 ± 17.2
E200-35C	3.2	27.75 ± 16.76	56.52 ± 7.10	13.15 ± 4.09	2669.1 ± 1222.0	1556.9 ± 537.3
E200-40C	2.6	28.14 ± 24.62	58.68 ± 12.80	11.66 ± 5.27	5708.8 ± 3631.7	2766.5 ± 1194.1
E200-45C	2.4	26.58 ± 20.55	60.69 ± 13.18	12.53 ± 4.52	3521.4 ± 1942.4	1582.5 ± 569.3
E200-50C	2.7	24.34 ± 9.52	60.49 ± 7.08	14.50 ± 3.40	2755.1 ± 1632.4	1901.6 ± 1103.3
E300-10C	1.1	18.87 ± 3.91	48.61 ± 4.62	36.62 ± 25.4	193.4 ± 87.3	85.5 ± 22.8
E300-15C	1.5	29.65 ± 6.24	48.38 ± 4.69	17.79 ± 5.97	165.1 ± 83.1	52.5 ± 27.6
E300-20C	1.5	28.77 ± 5.22	49.22 ± 4.05	17.22 ± 5.17	178.5 ± 79.6	57.1 ± 24.1
E300-25C	1.4	18.29 ± 6.50	52.25 ± 4.32	40.30 ± 26.8	220.2 ± 94.8	120.6 ± 27.1
E300-30C	2.0	27.04 ± 6.12	54.46 ± 6.98	17.81 ± 6.00	231.7 ± 92.4	98.0 ± 24.9
E300-35C	2.7	26.98 ± 8.14	55.89 ± 9.24	18.07 ± 8.50	281.5 ± 133.3	128.3 ± 36.0
E300-40C	2.4	26.36 ± 7.12	56.71 ± 8.64	18.56 ± 9.11	303.2 ± 127.8	151.2 ± 38.1
E300-45C	2.1	25.07 ± 5.05	56.79 ± 6.10	19.68 ± 9.02	324.5 ± 123.4	201.9 ± 54.8
E300-50C	1.8	24.33 ± 6.43	58.00 ± 6.93	20.81 ± 13.0	297.5 ± 166.6	238.6 ± 139.5

	N(water/PC head)	V_m of β-aescin	V_m of lipids	BackX	ScaleX
	#	Å^3	Å^3	cm^{-1}	-
E070-10C	1.77 ± 3.66	1202 ± 206	1051 ± 2	-0.0014 ± 0.0007	0.2343 ± 0.0727
E070-15C	1.68 ± 3.75	1189 ± 221	1058 ± 2	-0.0022 ± 0.0008	0.2339 ± 0.0744
E070-20C	2.67 ± 4.55	1194 ± 458	1066 ± 3	-0.0022 ± 0.0014	0.2539 ± 0.1851
E100-10C	4.30 ± 2.86	1401 ± 119	1057 ± 9	-0.0007 ± 0.0001	0.7392 ± 0.3161
E100-15C	4.54 ± 3.08	1390 ± 122	1062 ± 8	-0.0008 ± 0.0001	0.6968 ± 0.2943
E100-20C	4.73 ± 3.09	1373 ± 109	1073 ± 7	-0.0005 ± 0.0001	0.6661 ± 0.2419
E100-25C	6.48 ± 4.04	1191 ± 451	1080 ± 7	-0.0004 ± 0.0003	0.3347 ± 0.2754
E100-30C	2.89 ± 6.17	849 ± 2542	1093 ± 6	-0.0005 ± 0.0008	0.1485 ± 0.3876
E100-35C	3.80 ± 12.0	949 ± 2087	1098 ± 5	-0.0008 ± 0.0008	0.1684 ± 0.3905
E100-40C	0.00 ± 10.3	825 ± 1658	1103 ± 4	-0.0006 ± 0.0007	0.1284 ± 0.2051
E100-45C	0.00 ± 11.8	977 ± 984	1105 ± 4	-0.0006 ± 0.0005	0.1482 ± 0.1634
E100-50C	0.00 ± 10.4	883 ± 832	1109 ± 4	-0.0005 ± 0.0004	0.1325 ± 0.1106
E150-10C	3.77 ± 2.67	1382 ± 110	1063 ± 11	-0.0007 ± 0.0001	0.6466 ± 0.2605
E150-15C	4.11 ± 2.73	1376 ± 110	1066 ± 10	-0.0006 ± 0.0001	0.6032 ± 0.2437
E150-20C	4.97 ± 3.36	1366 ± 115	1074 ± 9	-0.0007 ± 0.0001	0.5718 ± 0.2274
E150-25C	6.30 ± 3.03	1339 ± 113	1080 ± 9	-0.0007 ± 0.0001	0.4596 ± 0.1840
E150-30C	7.18 ± 6.86	1262 ± 166	1087 ± 9	-0.0006 ± 0.0001	0.2724 ± 0.1556
E150-35C	5.06 ± 8.84	1162 ± 184	1090 ± 8	-0.0009 ± 0.0002	0.1948 ± 0.1098
E150-40C	5.57 ± 15.0	1069 ± 253	1092 ± 8	-0.0010 ± 0.0002	0.1465 ± 0.1011
E150-45C	6.30 ± 19.9	1070 ± 294	1094 ± 8	-0.0011 ± 0.0002	0.1485 ± 0.1197
E150-50C	7.80 ± 17.2	1024 ± 493	1096 ± 9	-0.0009 ± 0.0002	0.1241 ± 0.1304
E200-10C	5.38 ± 3.35	1451 ± 179	1069 ± 16	-0.0001 ± 0.0000	0.0894 ± 0.0706
E200-15C	4.97 ± 5.28	1405 ± 374	1073 ± 14	-0.0001 ± 0.0000	0.0724 ± 0.0835
E200-20C	5.19 ± 2.90	1393 ± 123	1078 ± 14	-0.0001 ± 0.0000	0.0593 ± 0.0253
E200-25C	6.42 ± 3.76	1420 ± 454	1084 ± 13	-0.0001 ± 0.0000	0.0677 ± 0.0842
E200-30C	6.66 ± 4.10	1338 ± 189	1088 ± 10	-0.0001 ± 0.0000	0.0431 ± 0.0248
E200-35C	7.52 ± 7.84	1151 ± 317	1088 ± 12	-0.0001 ± 0.0000	0.0182 ± 0.0144
E200-40C	8.46 ± 14.0	1076 ± 431	1088 ± 12	-0.0001 ± 0.0000	0.0139 ± 0.0146
E200-45C	9.30 ± 14.0	1148 ± 409	1093 ± 11	-0.0001 ± 0.0000	0.0180 ± 0.0190
E200-50C	7.57 ± 7.69	1122 ± 273	1100 ± 10	-0.0001 ± 0.0000	0.0153 ± 0.0096
E300-10C	5.37 ± 4.04	1429 ± 182	1107 ± 41	-0.0011 ± 0.0002	0.7477 ± 0.5206
E300-15C	4.27 ± 6.72	1406 ± 214	1104 ± 24	-0.0010 ± 0.0001	0.7755 ± 0.6455
E300-20C	4.37 ± 5.91	1381 ± 186	1111 ± 23	-0.0010 ± 0.0002	0.6826 ± 0.4653
E300-25C	6.15 ± 4.31	1437 ± 136	1133 ± 44	-0.0010 ± 0.0002	0.6801 ± 0.3717
E300-30C	4.88 ± 7.99	1342 ± 275	1127 ± 26	-0.0010 ± 0.0002	0.5263 ± 0.4797
E300-35C	6.25 ± 9.39	1352 ± 354	1117 ± 24	-0.0013 ± 0.0003	0.4978 ± 0.5715
E300-40C	6.46 ± 8.65	1350 ± 321	1117 ± 24	-0.0014 ± 0.0003	0.4644 ± 0.4709
E300-45C	5.48 ± 6.91	1323 ± 245	1120 ± 24	-0.0011 ± 0.0003	0.3872 ± 0.2627
E300-50C	7.03 ± 7.76	1355 ± 282	1120 ± 24	-0.0011 ± 0.0003	0.3963 ± 0.3052

	$\Delta\rho_{\text{heads}}$ cm/Å^3	$\Delta\rho_{\text{alkyl}}$ cm/Å^3	$\Delta\rho_{\text{methyl}}$ cm/Å^3	$\Delta\rho_{\text{rim}}$ cm/Å^3	h_{bl} Å	h_{al} Å	h_{me} Å	$\overline{N}_{\text{lip}}$ #	r_{core} for $\overline{N}_{\text{lip}}$ Å
E070-10C	$4.03 \cdot 10^{-14}$	$-5.02 \cdot 10^{-15}$	$-4.88 \cdot 10^{-14}$	$4.83 \cdot 10^{-14}$	47.70	31.13	4.86	3035.2	149.5
E070-15C	$3.99 \cdot 10^{-14}$	$-5.61 \cdot 10^{-15}$	$-4.91 \cdot 10^{-14}$	$4.98 \cdot 10^{-14}$	47.70	31.23	4.87	3105.9	151.5
E070-20C	$3.62 \cdot 10^{-14}$	$-6.30 \cdot 10^{-15}$	$-4.95 \cdot 10^{-14}$	$4.93 \cdot 10^{-14}$	48.07	30.66	4.78	2609.7	140.7
E100-10C	$3.31 \cdot 10^{-14}$	$-5.53 \cdot 10^{-15}$	$-4.91 \cdot 10^{-14}$	$2.81 \cdot 10^{-14}$	49.80	30.43	4.75	1637.2	111.4
E100-15C	$3.22 \cdot 10^{-14}$	$-6.01 \cdot 10^{-15}$	$-4.93 \cdot 10^{-14}$	$2.90 \cdot 10^{-14}$	49.81	30.28	4.72	1669.1	113.1
E100-20C	$3.09 \cdot 10^{-14}$	$-6.87 \cdot 10^{-15}$	$-4.97 \cdot 10^{-14}$	$3.06 \cdot 10^{-14}$	49.48	29.97	4.68	1558.7	110.4
E100-25C	$2.73 \cdot 10^{-14}$	$-7.45 \cdot 10^{-15}$	$-5.00 \cdot 10^{-14}$	$4.95 \cdot 10^{-14}$	48.52	28.20	4.40	3104.7	161.1
E100-30C	$3.30 \cdot 10^{-14}$	$-8.50 \cdot 10^{-15}$	$-5.06 \cdot 10^{-14}$	$1.07 \cdot 10^{-13}$	43.66	27.74	4.33	9345.1	283.5
E100-35C	$3.06 \cdot 10^{-14}$	$-8.88 \cdot 10^{-15}$	$-5.08 \cdot 10^{-14}$	$8.62 \cdot 10^{-14}$	42.60	26.47	4.13	11566.5	323.7
E100-40C	$4.01 \cdot 10^{-14}$	$-9.25 \cdot 10^{-15}$	$-5.10 \cdot 10^{-14}$	$1.13 \cdot 10^{-13}$	39.95	27.40	4.27	14103.0	352.0
E100-45C	$3.99 \cdot 10^{-14}$	$-9.38 \cdot 10^{-15}$	$-5.10 \cdot 10^{-14}$	$8.10 \cdot 10^{-14}$	38.67	26.51	4.14	14403.1	361.9
E100-50C	$3.94 \cdot 10^{-14}$	$-9.69 \cdot 10^{-15}$	$-5.12 \cdot 10^{-14}$	$9.97 \cdot 10^{-14}$	39.08	26.80	4.18	13299.3	346.6
E150-10C	$3.38 \cdot 10^{-14}$	$-6.05 \cdot 10^{-15}$	$-4.93 \cdot 10^{-14}$	$2.98 \cdot 10^{-14}$	50.05	31.02	4.84	953.3	84.4
E150-15C	$3.27 \cdot 10^{-14}$	$-6.30 \cdot 10^{-15}$	$-4.95 \cdot 10^{-14}$	$3.03 \cdot 10^{-14}$	50.06	30.77	4.80	1009.4	87.4
E150-20C	$3.04 \cdot 10^{-14}$	$-6.93 \cdot 10^{-15}$	$-4.98 \cdot 10^{-14}$	$3.12 \cdot 10^{-14}$	50.16	30.20	4.71	971.1	86.8
E150-25C	$2.76 \cdot 10^{-14}$	$-7.43 \cdot 10^{-15}$	$-5.00 \cdot 10^{-14}$	$3.37 \cdot 10^{-14}$	49.40	28.83	4.50	1233.7	100.4
E150-30C	$2.58 \cdot 10^{-14}$	$-8.01 \cdot 10^{-15}$	$-5.03 \cdot 10^{-14}$	$4.15 \cdot 10^{-14}$	46.53	26.63	4.16	3169.4	168.0
E150-35C	$2.89 \cdot 10^{-14}$	$-8.26 \cdot 10^{-15}$	$-5.05 \cdot 10^{-14}$	$5.31 \cdot 10^{-14}$	44.56	26.82	4.18	5618.9	223.3
E150-40C	$2.79 \cdot 10^{-14}$	$-8.42 \cdot 10^{-15}$	$-5.05 \cdot 10^{-14}$	$6.60 \cdot 10^{-14}$	43.44	25.84	4.03	10910.6	317.3
E150-45C	$2.66 \cdot 10^{-14}$	$-8.53 \cdot 10^{-15}$	$-5.06 \cdot 10^{-14}$	$6.58 \cdot 10^{-14}$	42.45	24.82	3.87	12216.5	342.8
E150-50C	$2.44 \cdot 10^{-14}$	$-8.70 \cdot 10^{-15}$	$-5.07 \cdot 10^{-14}$	$7.30 \cdot 10^{-14}$	42.50	24.02	3.75	9284.8	304.1
E200-10C	$3.00 \cdot 10^{-14}$	$-6.57 \cdot 10^{-15}$	$-4.96 \cdot 10^{-14}$	$2.39 \cdot 10^{-14}$	50.99	30.38	4.74	458.8	59.4
E200-15C	$3.04 \cdot 10^{-14}$	$-6.91 \cdot 10^{-15}$	$-4.98 \cdot 10^{-14}$	$2.77 \cdot 10^{-14}$	50.90	30.64	4.78	491.6	61.3
E200-20C	$2.96 \cdot 10^{-14}$	$-7.30 \cdot 10^{-15}$	$-5.00 \cdot 10^{-14}$	$2.88 \cdot 10^{-14}$	50.73	30.39	4.74	593.6	67.8
E200-25C	$2.72 \cdot 10^{-14}$	$-7.75 \cdot 10^{-15}$	$-5.02 \cdot 10^{-14}$	$2.65 \cdot 10^{-14}$	49.89	29.05	4.53	510.8	64.5
E200-30C	$2.65 \cdot 10^{-14}$	$-8.08 \cdot 10^{-15}$	$-5.04 \cdot 10^{-14}$	$3.39 \cdot 10^{-14}$	47.05	27.26	4.25	974.7	92.1
E200-35C	$2.53 \cdot 10^{-14}$	$-8.08 \cdot 10^{-15}$	$-5.04 \cdot 10^{-14}$	$5.46 \cdot 10^{-14}$	46.49	26.40	4.12	2811.5	159.0
E200-40C	$2.41 \cdot 10^{-14}$	$-8.10 \cdot 10^{-15}$	$-5.04 \cdot 10^{-14}$	$6.49 \cdot 10^{-14}$	45.74	25.43	3.97	5830.4	233.3
E200-45C	$2.28 \cdot 10^{-14}$	$-8.46 \cdot 10^{-15}$	$-5.06 \cdot 10^{-14}$	$5.49 \cdot 10^{-14}$	45.21	24.70	3.85	3568.1	185.7
E200-50C	$2.45 \cdot 10^{-14}$	$-9.00 \cdot 10^{-15}$	$-5.08 \cdot 10^{-14}$	$5.84 \cdot 10^{-14}$	43.87	24.93	3.89	3033.1	170.9
E300-10C	$2.71 \cdot 10^{-14}$	$-9.57 \cdot 10^{-15}$	$-5.11 \cdot 10^{-14}$	$2.57 \cdot 10^{-14}$	52.18	31.23	4.87	195.7	38.9
E300-15C	$2.92 \cdot 10^{-14}$	$-9.34 \cdot 10^{-15}$	$-5.10 \cdot 10^{-14}$	$2.77 \cdot 10^{-14}$	50.93	31.30	4.88	165.1	35.7
E300-20C	$2.85 \cdot 10^{-14}$	$-9.85 \cdot 10^{-15}$	$-5.13 \cdot 10^{-14}$	$2.98 \cdot 10^{-14}$	50.46	30.95	4.83	178.5	37.4
E300-25C	$2.41 \cdot 10^{-14}$	$-1.15 \cdot 10^{-14}$	$-5.21 \cdot 10^{-14}$	$2.50 \cdot 10^{-14}$	50.41	29.73	4.64	229.0	42.6
E300-30C	$2.64 \cdot 10^{-14}$	$-1.10 \cdot 10^{-14}$	$-5.19 \cdot 10^{-14}$	$3.35 \cdot 10^{-14}$	46.75	28.37	4.43	233.7	45.0
E300-35C	$2.50 \cdot 10^{-14}$	$-1.03 \cdot 10^{-14}$	$-5.15 \cdot 10^{-14}$	$3.25 \cdot 10^{-14}$	46.70	27.42	4.28	285.6	50.4
E300-40C	$2.48 \cdot 10^{-14}$	$-1.03 \cdot 10^{-14}$	$-5.15 \cdot 10^{-14}$	$3.25 \cdot 10^{-14}$	46.22	27.00	4.21	310.8	53.0
E300-45C	$2.60 \cdot 10^{-14}$	$-1.05 \cdot 10^{-14}$	$-5.16 \cdot 10^{-14}$	$3.51 \cdot 10^{-14}$	45.24	27.05	4.22	346.9	56.0
E300-50C	$2.38 \cdot 10^{-14}$	$-1.05 \cdot 10^{-14}$	$-5.16 \cdot 10^{-14}$	$3.22 \cdot 10^{-14}$	45.89	26.48	4.13	345.3	56.5

Table S2 Parameters of the *ribbon* model. χ^2: goodness of fit; Scaling: scale parameter; Background; A(lipid): Area per lipid head group; V_m: partial molar volume; Axis Ratio (c/b): axial ratio between the ribbon sides $c_{\text{ribbon}}/b_{\text{ribbon}}$; Roughness: roughness of lipid bilayer; $\Delta\rho_{\text{shell}}$: excess scattering length densities of the shell (DMPC head groups + β-aescin molecule); $\Delta\rho_{\text{core}}$: excess scattering length densities of core (DMPC alkyl chains); h_{core}: height of alkyl chain layer; $\mu(N_{\text{lip}})$: peak of the distribution of the number of lipids N_{lip}; $\overline{N}_{\text{lip}}$: mean number of lipids; $c_{\text{core}} = c_{\text{ribbon}} - 2t_{\text{shell}}$: length of ribbon core for N_{lip}(mean); $b_{\text{core}} = b_{\text{ribbon}} - 2t_{\text{shell}}$ for $\overline{N}_{\text{lip}}$: width of ribbon core; t_{shell} for $\overline{N}_{\text{lip}}$: thickness of shell.

	χ^2	Scaling	Background	A(lipid)	V_m of lipids
	-	-	10^{-3}cm^{-1}	Å^2	Å^3
E070-10C	112.5	0.0022 ± 0.0002	0.0025 ± 0.0001	55.70 ± 0.80	1080 ± 2
E070-15C	58.2	0.0023 ± 0.0002	0.0032 ± 0.0001	54.97 ± 0.64	1083 ± 2
E070-20C	106.1	0.0025 ± 0.0002	0.0033 ± 0.0001	55.14 ± 0.64	1086 ± 2
E100-10C	16.4	0.0264 ± 0.0304	0.0009 ± 0.0001	50.39 ± 3.19	1073 ± 9
E100-15C	14.0	0.0260 ± 0.0579	0.0010 ± 0.0001	50.70 ± 2.79	1082 ± 8
E100-20C	20.5	0.0305 ± 0.0641	0.0007 ± 0.0001	52.28 ± 2.69	1089 ± 7
E100-25C	21.5	0.0110 ± 0.0148	0.0007 ± 0.0001	56.03 ± 2.98	1098 ± 5
E100-30C	16.1	0.0100 ± 0.0006	0.0007 ± 0.0001	60.26 ± 1.85	1114 ± 2
E100-35C	9.4	0.0064 ± 0.0075	0.0010 ± 0.0001	63.90 ± 3.02	1121 ± 4
E100-40C	17.6	0.0027 ± 0.0023	0.0009 ± 0.0001	65.83 ± 2.12	1129 ± 4
E100-45C	12.2	0.0002 ± 0.0001	0.0008 ± 0.0001	75.55 ± 2.63	1197 ± 6
E100-50C	28.7	0.0023 ± 0.0017	0.0007 ± 0.0001	68.11 ± 1.78	1133 ± 3
E150-10C	14.2	0.0665 ± 0.0689	0.0009 ± 0.0001	50.97 ± 3.02	1082 ± 9
E150-15C	11.9	0.0629 ± 0.0615	0.0008 ± 0.0001	51.47 ± 2.91	1086 ± 8
E150-20C	9.5	0.0642 ± 0.0719	0.0009 ± 0.0001	52.93 ± 3.14	1094 ± 8
E150-25C	6.2	0.0451 ± 0.1067	0.0010 ± 0.0001	56.33 ± 3.48	1108 ± 7
E150-30C	4.6	0.0270 ± 0.0397	0.0008 ± 0.0001	60.52 ± 3.53	1119 ± 6
E150-35C	5.4	0.0140 ± 0.0196	0.0010 ± 0.0001	63.85 ± 3.89	1134 ± 6
E150-40C	4.6	0.0108 ± 0.0118	0.0011 ± 0.0001	64.59 ± 3.84	1126 ± 6
E150-45C	3.5	0.0114 ± 0.0101	0.0012 ± 0.0001	67.02 ± 3.61	1130 ± 6
E150-50C	3.3	0.0195 ± 0.0140	0.0011 ± 0.0001	69.21 ± 3.80	1133 ± 6
E200-10C	6.8	0.0056 ± 0.0057	0.0001 ± 0.0000	50.98 ± 3.59	1086 ± 10
E200-15C	7.0	0.0066 ± 0.0102	0.0001 ± 0.0000	51.36 ± 3.38	1090 ± 10
E200-20C	8.1	0.0080 ± 0.0170	0.0001 ± 0.0000	53.02 ± 3.44	1098 ± 9
E200-25C	5.9	0.0125 ± 0.0161	0.0001 ± 0.0000	55.82 ± 3.54	1110 ± 8
E200-30C	5.2	0.0067 ± 0.0096	0.0001 ± 0.0000	59.57 ± 3.33	1121 ± 7
E200-35C	2.9	0.0039 ± 0.0070	0.0001 ± 0.0000	62.22 ± 4.08	1128 ± 7
E200-40C	3.2	0.0032 ± 0.0036	0.0001 ± 0.0000	65.23 ± 5.11	1133 ± 7
E200-45C	3.0	0.0039 ± 0.0043	0.0001 ± 0.0000	67.30 ± 4.97	1135 ± 8
E200-50C	3.4	0.0051 ± 0.0063	0.0001 ± 0.0000	66.96 ± 4.17	1136 ± 6
E300-10C	7.5	0.6409 ± 4.7968	0.0015 ± 0.0001	51.47 ± 6.91	1099 ± 15
E300-15C	7.9	0.5886 ± 4.2984	0.0013 ± 0.0001	51.75 ± 7.02	1101 ± 16
E300-20C	7.0	0.5505 ± 4.0196	0.0013 ± 0.0001	52.92 ± 7.70	1107 ± 17
E300-25C	5.3	0.3901 ± 2.4223	0.0013 ± 0.0001	55.32 ± 6.53	1114 ± 13
E300-30C	4.1	0.3687 ± 1.3163	0.0013 ± 0.0002	58.15 ± 5.24	1122 ± 10
E300-35C	3.4	0.3060 ± 0.7680	0.0017 ± 0.0002	61.51 ± 6.37	1128 ± 13
E300-40C	2.5	1.2318 ± 9.1318	0.0018 ± 0.0002	90.68 ± 29.96	1162 ± 22
E300-45C	3.2	1.4467 ± 10.9070	0.0016 ± 0.0002	96.24 ± 33.34	1165 ± 22
E300-50C	2.9	2.0761 ± 15.7853	0.0015 ± 0.0002	105.14 ± 37.46	1170 ± 20

	$\mu(N_{\text{lip}})$ #	$\sigma(N_{\text{lip}})$ #	Axis Ratio (c/b) -	Roughness Å
E070-10C	743.7 ± 1406.6	22765.3 ± 2276.97	4.74 ± 0.43	4.78 ± 0.23
E070-15C	1468.6 ± 1351.8	19821.7 ± 2104.27	5.65 ± 0.49	4.50 ± 0.20
E070-20C	311.6 ± 1260.1	20114.7 ± 1732.27	6.64 ± 0.55	4.51 ± 0.20
E100-10C	159.4 ± 1735.2	1441.3 ± 867.5	3.59 ± 1.85	4.40 ± 0.56
E100-15C	97.7 ± 5316.8	1894.2 ± 2983.1	9.73 ± 8.38	4.46 ± 0.62
E100-20C	52.4 ± 4051.1	1651.4 ± 2059.2	8.14 ± 4.99	4.42 ± 0.52
E100-25C	655.1 ± 4182.9	3088.2 ± 2440.4	7.75 ± 5.23	4.08 ± 0.45
E100-30C	107.3 ± 205.9	4435.2 ± 229.2	7.42 ± 1.72	3.86 ± 0.30
E100-35C	0.0 ± 7363.7	7791.5 ± 7907.6	11.7 ± 10.5	3.92 ± 0.62
E100-40C	0.0 ± 14999.4	17855.1 ± 16311.6	9.19 ± 6.92	3.82 ± 0.51
E100-45C	43655.1 ± 7603.1	100.0 ± 38691.7	2.01 ± 0.42	1.24 ± 2.86
E100-50C	0.0 ± 14063.0	18774.9 ± 15649.2	9.75 ± 6.60	3.40 ± 0.42
E150-10C	14.0 ± 781.8	745.2 ± 355.2	2.49 ± 1.31	4.52 ± 0.52
E150-15C	22.1 ± 800.2	785.5 ± 388.3	2.80 ± 1.18	4.48 ± 0.51
E150-20C	20.3 ± 915.0	788.0 ± 438.5	3.27 ± 1.24	4.40 ± 0.55
E150-25C	34.1 ± 3288.2	1245.4 ± 1497.6	6.78 ± 4.13	4.64 ± 0.68
E150-30C	0.0 ± 3589.4	2085.5 ± 2203.7	7.24 ± 4.69	4.48 ± 0.61
E150-35C	233.0 ± 3909.5	2823.5 ± 2386.7	7.34 ± 4.31	3.97 ± 0.61
E150-40C	531.6 ± 3912.8	3744.3 ± 3383.7	7.01 ± 5.00	4.00 ± 0.69
E150-45C	0.0 ± 3538.6	4333.6 ± 3450.6	4.48 ± 3.16	4.20 ± 0.72
E150-50C	28.7 ± 1757.0	2680.7 ± 1464.2	2.15 ± 1.30	4.28 ± 0.71
E200-10C	399.5 ± 387.6	205.7 ± 300.6	1.74 ± 0.58	4.71 ± 0.59
E200-15C	334.2 ± 609.7	253.4 ± 364.5	1.72 ± 0.60	4.61 ± 0.55
E200-20C	269.0 ± 871.7	296.4 ± 458.0	1.95 ± 0.62	4.75 ± 0.55
E200-25C	0.0 ± 695.3	517.0 ± 291.6	3.28 ± 1.52	4.75 ± 0.57
E200-30C	15.6 ± 1418.4	910.0 ± 695.8	4.70 ± 2.71	4.58 ± 0.56
E200-35C	0.0 ± 2831.8	1508.2 ± 1408.1	6.00 ± 4.22	4.44 ± 0.69
E200-40C	0.0 ± 2636.8	1886.0 ± 1646.8	4.77 ± 3.69	4.57 ± 0.83
E200-45C	21.0 ± 1622.4	1517.3 ± 914.1	3.01 ± 1.54	4.58 ± 0.87
E200-50C	0.0 ± 1535.1	1175.2 ± 816.2	4.67 ± 2.94	4.51 ± 0.69
E300-10C	0.0 ± 1200.7	146.5 ± 421.4	1.46 ± 1.17	5.13 ± 0.65
E300-15C	0.0 ± 1212.3	151.2 ± 424.8	1.36 ± 1.39	4.97 ± 0.68
E300-20C	0.0 ± 1263.4	157.4 ± 439.7	1.31 ± 1.61	4.92 ± 0.78
E300-25C	6.8 ± 1203.7	195.2 ± 386.2	1.18 ± 1.99	4.79 ± 0.87
E300-30C	0.0 ± 810.0	218.8 ± 278.7	1.78 ± 1.11	4.69 ± 0.66
E300-35C	5.9 ± 709.1	266.6 ± 261.1	2.24 ± 1.19	4.85 ± 0.95
E300-40C	0.0 ± 1551.1	208.2 ± 525.8	2.63 ± 1.29	6.74 ± 0.93
E300-45C	0.0 ± 1495.5	199.6 ± 501.8	2.69 ± 1.36	6.78 ± 0.82
E300-50C	0.0 ± 1325.1	174.0 ± 447.2	2.55 ± 1.21	6.87 ± 0.65

	$\Delta\rho_{\text{shell}}$ cm/Å^3	$\Delta\rho_{\text{core}}$ cm/Å^3	h_{core} Å	$\overline{N}_{\text{lip}}$ #	b_{core} for $\overline{N}_{\text{lip}}$ Å	c_{core} for $\overline{N}_{\text{lip}}$ Å	t_{shell} for $\overline{N}_{\text{lip}}$ Å
E070-10C	$4.05 \cdot 10^{-14}$	$-1.41 \cdot 10^{-14}$	26.59	18325.70	328.45	1554.04	15.44
E070-15C	$4.02 \cdot 10^{-14}$	$-1.43 \cdot 10^{-14}$	27.02	16232.82	281.05	1587.43	15.30
E070-20C	$3.98 \cdot 10^{-14}$	$-1.45 \cdot 10^{-14}$	27.01	16028.75	257.97	1713.20	15.12
E100-10C	$4.04 \cdot 10^{-14}$	$-1.35 \cdot 10^{-14}$	29.19	1200.73	91.86	329.32	11.66
E100-15C	$3.95 \cdot 10^{-14}$	$-1.42 \cdot 10^{-14}$	29.27	1535.06	63.25	615.23	10.79
E100-20C	$3.89 \cdot 10^{-14}$	$-1.48 \cdot 10^{-14}$	28.57	1325.94	65.24	531.27	10.65
E100-25C	$3.81 \cdot 10^{-14}$	$-1.54 \cdot 10^{-14}$	26.88	2699.09	98.80	765.35	11.84
E100-30C	$3.67 \cdot 10^{-14}$	$-1.65 \cdot 10^{-14}$	25.35	3548.62	120.03	890.81	11.98
E100-35C	$3.61 \cdot 10^{-14}$	$-1.70 \cdot 10^{-14}$	24.07	6164.31	129.81	1517.13	11.92
E100-40C	$3.54 \cdot 10^{-14}$	$-1.76 \cdot 10^{-14}$	23.52	14126.21	224.99	2066.67	13.10
E100-45C	$2.99 \cdot 10^{-14}$	$-2.19 \cdot 10^{-14}$	21.73	43655.10	906.73	1818.65	13.67
E100-50C	$3.51 \cdot 10^{-14}$	$-1.78 \cdot 10^{-14}$	22.81	14853.89	227.72	2221.22	12.80
E150-10C	$3.86 \cdot 10^{-14}$	$-1.42 \cdot 10^{-14}$	29.12	594.73	78.09	194.08	10.44
E150-15C	$3.83 \cdot 10^{-14}$	$-1.46 \cdot 10^{-14}$	28.95	629.67	76.11	212.89	10.44
E150-20C	$3.77 \cdot 10^{-14}$	$-1.51 \cdot 10^{-14}$	28.34	630.90	71.51	233.49	10.21
E150-25C	$3.66 \cdot 10^{-14}$	$-1.61 \cdot 10^{-14}$	26.97	997.91	64.39	436.49	10.07
E150-30C	$3.57 \cdot 10^{-14}$	$-1.69 \cdot 10^{-14}$	25.36	1649.97	83.03	601.33	10.66
E150-35C	$3.43 \cdot 10^{-14}$	$-1.79 \cdot 10^{-14}$	24.36	2321.46	100.48	737.60	10.99
E150-40C	$3.52 \cdot 10^{-14}$	$-1.74 \cdot 10^{-14}$	23.92	3165.69	120.73	846.79	11.45
E150-45C	$3.49 \cdot 10^{-14}$	$-1.76 \cdot 10^{-14}$	23.13	3428.57	160.17	717.27	11.76
E150-50C	$3.47 \cdot 10^{-14}$	$-1.78 \cdot 10^{-14}$	22.45	2131.38	185.34	397.93	11.37
E200-10C	$3.77 \cdot 10^{-14}$	$-1.45 \cdot 10^{-14}$	29.21	411.40	77.74	134.90	9.87
E200-15C	$3.74 \cdot 10^{-14}$	$-1.48 \cdot 10^{-14}$	29.11	379.74	75.39	129.35	9.69
E200-20C	$3.68 \cdot 10^{-14}$	$-1.54 \cdot 10^{-14}$	28.40	363.34	70.36	136.88	9.45
E200-25C	$3.59 \cdot 10^{-14}$	$-1.62 \cdot 10^{-14}$	27.27	409.05	59.00	193.49	9.16
E200-30C	$3.52 \cdot 10^{-14}$	$-1.70 \cdot 10^{-14}$	25.81	725.71	67.82	318.70	9.72
E200-35C	$3.47 \cdot 10^{-14}$	$-1.75 \cdot 10^{-14}$	24.86	1193.23	78.63	472.09	10.19
E200-40C	$3.44 \cdot 10^{-14}$	$-1.78 \cdot 10^{-14}$	23.81	1492.11	100.99	481.86	10.61
E200-45C	$3.42 \cdot 10^{-14}$	$-1.80 \cdot 10^{-14}$	23.13	1208.13	116.31	349.52	10.50
E200-50C	$3.41 \cdot 10^{-14}$	$-1.80 \cdot 10^{-14}$	23.26	929.73	81.68	381.08	9.71
E300-10C	$3.59 \cdot 10^{-14}$	$-1.55 \cdot 10^{-14}$	29.28	115.94	45.27	65.92	7.23
E300-15C	$3.58 \cdot 10^{-14}$	$-1.56 \cdot 10^{-14}$	29.19	119.62	47.63	64.98	7.31
E300-20C	$3.55 \cdot 10^{-14}$	$-1.60 \cdot 10^{-14}$	28.68	124.53	50.19	65.65	7.38
E300-25C	$3.50 \cdot 10^{-14}$	$-1.65 \cdot 10^{-14}$	27.62	156.94	60.67	71.55	7.80
E300-30C	$3.45 \cdot 10^{-14}$	$-1.71 \cdot 10^{-14}$	26.47	173.07	53.11	94.74	7.79
E300-35C	$3.42 \cdot 10^{-14}$	$-1.75 \cdot 10^{-14}$	25.14	213.14	54.05	121.27	7.96
E300-40C	$3.22 \cdot 10^{-14}$	$-1.97 \cdot 10^{-14}$	17.57	164.73	53.32	140.07	6.54
E300-45C	$3.20 \cdot 10^{-14}$	$-1.99 \cdot 10^{-14}$	16.60	157.90	53.13	143.02	6.33
E300-50C	$3.17 \cdot 10^{-14}$	$-2.02 \cdot 10^{-14}$	15.26	137.63	53.31	135.72	5.97

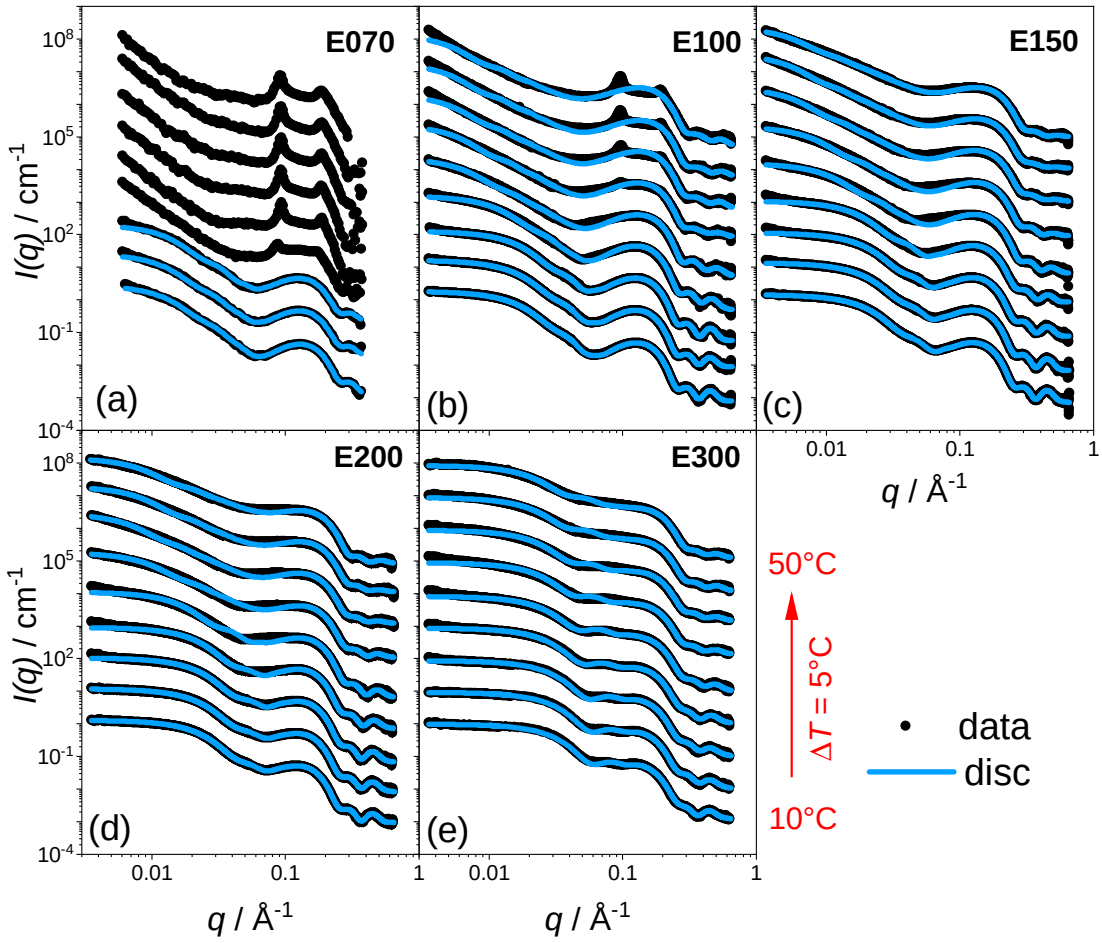

Fig. S2 SAXS curves of samples with (a) 7 mol% , (b) 10 mol%, (c) 15 mol%, (d) 20 mol%, and (e) 30 mol% β-aescin at temperatures from 10-50 °C (red numbers) in steps of 5 °C. Solid lines are model fits to the data (black dots). Blue: *polyidisperse disc*. The SAXS curves are scaled by multiples of 10 from bottom (10^0 @ 10 °C) to top (10^8 @ 50 °C). The legend and temperatures apply to all panels. The samples of E070 (panel (a)) were measured at the XEUSS instrument, all other samples at the ID02 beamline.

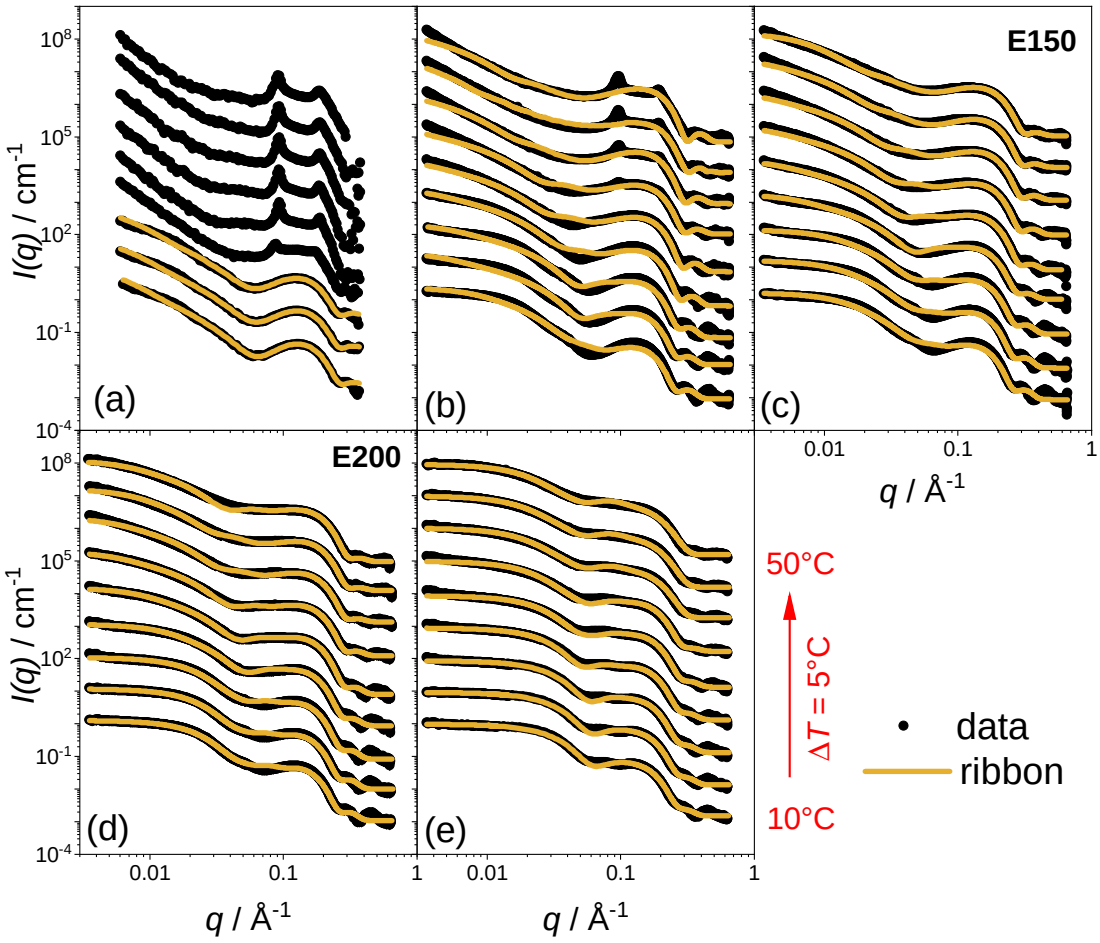

Fig. S3 SAXS curves of samples with (a) 7 mol% , (b) 10 mol%, (c) 15 mol%, (d) 20 mol%, and (e) 30 mol% β-aescin at temperatures from 10-50 °C (red numbers) in steps of 5 °C. Solid lines are model fits to the data (black dots). Orange: *extended bilayer* (*polydisperse ribbon*) model. The SAXS curves are scaled by multiples of 10 from bottom (10^0 @ 10 °C) to top (10^8 @ 50 °C). The legend and temperatures apply to all panels. The samples of E070 (panel (a)) were measured at the XEUSS instrument, all other samples at the ID02 beamline.