Dependent Scattering Effects in Aggregates with Touching or Overlapping Non-Absorbing Spherical Particles Supporting Information

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Table S1: Orientation-averaged and fixed scattering efficiency factor and asymmetry factor of aggregates with point-contact and surface-contact particles computed using the T-matrix method.

Aggregate type	**Particle size parameter** x_s	**Aggregate size parameter** χ_s	**Porosity** ϕ (%)	**Orientation-averaged**		**Fixed orientation**		**Relative error**	
				Q^a_{sca}	g^a	Q^a_{sca}	g^a	$\lvert Q^f_{sca} - Q^o_{sca}\rvert / Q^o_{sca}$ (%) [a]	$\lvert g^f - g^o\rvert / g^o$ (%)
Point-contact	0.031	0.72	66	0.013	0.082	0.014	0.083	0.26	0.7
Point-contact	0.031	0.79	66.2	0.018	0.1	0.018	0.1	0	0.06
Point-contact	0.031	0.85	66.1	0.024	0.12	0.024	0.11	0.8	3.3
Point-contact	0.031	0.47	67.3	0.00237	0.039	0.00239	0.04	0.6	2.22
Point-contact	0.031	0.78	66.8	0.017	0.11	0.017	0.11	0.11	1.47
Point-contact	0.063	0.78	67	0.016	0.11	0.016	0.11	0.1	0.9
Point-contact	0.063	1.17	67.1	0.064	0.25	0.064	0.26	0.8	3.9
Point-contact	0.063	1.56	66.8	0.147	0.45	0.146	0.46	0.5	3
Point-contact	0.13	1.56	67	0.147	0.45	0.146	0.46	0.7	3
Point-contact	0.25	3.12	67	0.835	0.79	0.835	0.74	0.05	5.7
Point-contact	0.25	3.9	67.1	1.35	0.86	1.28	0.87	5.3	1.1
Point-contact	0.63	3.9	66.5	1.49	0.81	1.4	0.82	6.3	0.9
Point-contact	0.63	7.8	67	4.89	0.91	5	0.92	2.5	1.56
Point-contact	1.26	7.8	66.5	5.34	0.81	5.4	0.74	1.15	8.5
Point-contact	1.26	9.35	66.8	6.11	0.81	6.5	0.75	6.42	7.5
Point-contact	1.26	10.9	67.6	6.5	0.81	7.05	0.76	8.5	6.2
Point-contact	1.26	12.5	67.3	6.54	0.8	7.42	0.77	13.6	4.2
Point-contact	2.51	14	66.1	5	0.69	4.67	0.68	6.76	28.1
Point-contact	2.51	15.6	66.9	5.1	0.68	5.56	0.74	9.52	22
Point-contact	2.51	17.9	66.4	5	0.67	3.78	0.64	24.3	31.5
Point-contact	2.51	19.5	67.2	4.88	0.65	4.1	0.61	16	34.4
Point-contact	2.51	21	67.1	5	0.65	4.38	0.64	12.1	30.1
Surface-contact	0.063	0.63	67.7	7.36×10^{-3}	6.72×10^{-2}	7.44×10^{-3}	6.64×10^{-2}	0.96	1.25
Surface-contact	0.25	3.11	66.6	0.932	0.776	0.957	0.7	2.65	9.76
Surface-contact	0.63	3.89	66.3	1.75	0.789	1.7	0.792	2.62	0.29
Surface-contact	1.25	10.9	66.1	5.78	0.775	6.74	0.797	16.7	2.69
Surface-contact	0.063	1.56	94.8	1.316×10^{-2}	0.283	1.319×10^{-2}	0.284	0.17	0.9
Surface-contact	0.063	1.56	49.4	0.287	0.481	0.288	0.482	0.3	0.1
Surface-contact	0.13	3.12	49.6	1.5442	0.782	1.5441	0.781	0.006	0.13

[a] "o" refers to orientation-averaged and "f" refers to fixed orientation.

Table S2: Scattering cross-section and asymmetry factor of aggregates with point-contact and surface-contact particles.

Particle size parameter x_s	**Aggregate size parameter** χ_s	**Point-contact particles** ϕ (%)	C^a_{sca} (**nm**^{2})	g^a	**Surface-contact particles** ϕ (%)	C^a_{sca} (**nm**^{2})	g^a	**Relative error** $\lvert C^{PC}_{sca} - C^{SC}_{sca}\rvert / C^{SC}_{sca}$ (%) [a]	$\lvert g^{PC} - g^{SC}\rvert / g^{SC}$ (%)
1.26	3.9	66.4	3.01x10^5	0.63	68.9	2.83x10^5	0.71	6	10
1.26	5.9	67.2	1.21x10^6	0.77	67.8	1.35x10^5	0.82	10	6
1.26	7.8	66.5	3.11x10^6	0.81	67.6	3.09x10^6	0.81	0.6	0
1.26	10.9	67.6	7.26x10^6	0.81	66	6.66x10^6	0.78	9	5
1.26	12.5	67.3	9.61x10^6	0.8	66.6	8.62x10^6	0.76	11	6
0.63	3.9	66.5	2.18x10^5	0.81	66.2	2.56x10^5	0.79	15	3
0.63	6.3	67.5	1.26x10^6	0.88	67.7	1.39x10^6	0.86	9	3
0.63	7.8	67	2.82x10^6	0.91	66.9	3.01x10^6	0.88	6	3
0.25	3.11	67	7.71x10^4	0.79	66.6	8.67x10^4	0.78	11	2
0.25	3.9	67.1	1.95x10^5	0.86	67.9	2.05x10^5	0.85	5	1
0.13	1.56	66.8	3.38x10^3	0.45	66.7	3.74x10^3	0.43	10	4
0.063	0.62	65.9	28.4	0.07	67.7	26.8	0.67	6	5

[a] "PC" refers to aggregates with point-contact particles and "SC" refers to aggregates with surface-contact particles.

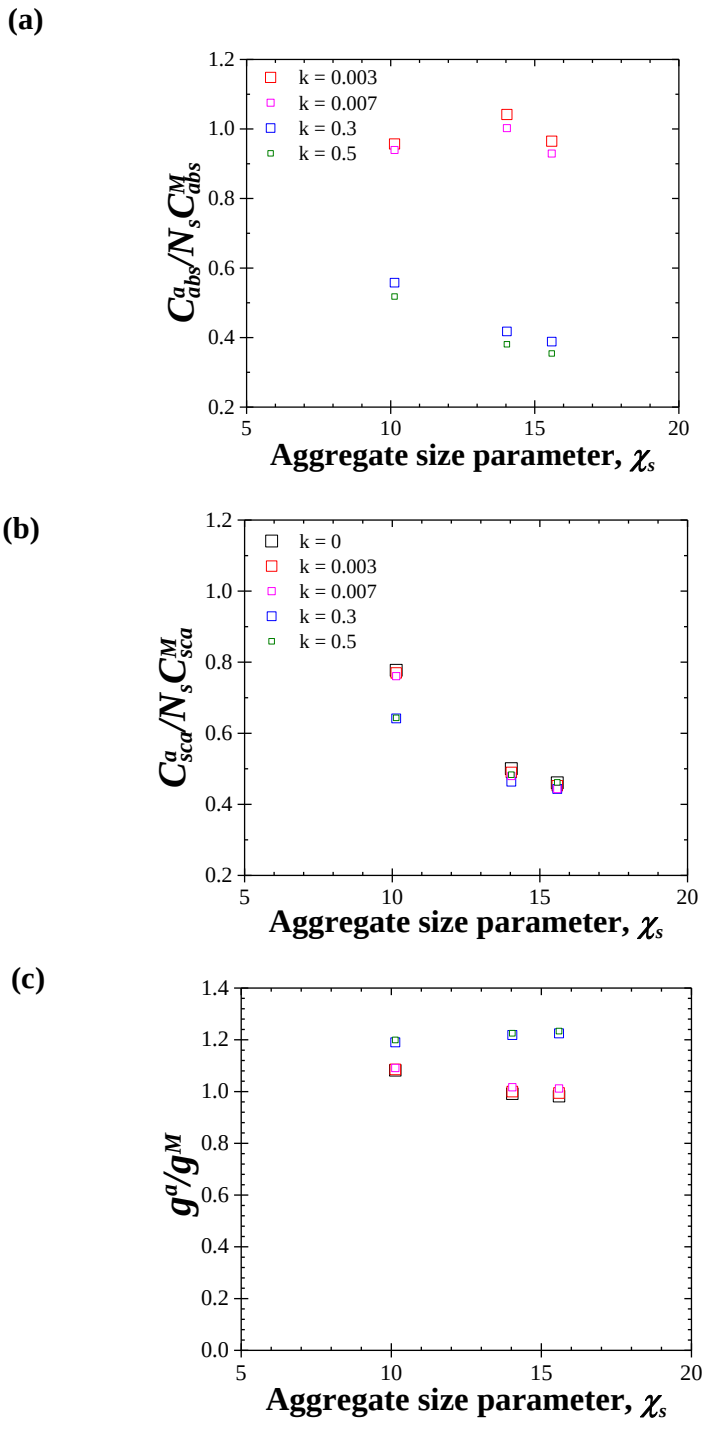

Figure S1: (a) Absorption cross-section ratio $C^a_{abs}/N_sC^M_{abs}$, (b) scattering cross-section ratio $C^a_{sca}/N_sC^M_{sca}$, and (c) asymmetry factor ratio g^a/g^M as functions of the aggregate size parameter χ_s for aggregates with particle size parameter $x_s = 2.51$, particle volume fraction $f_v = 33\pm2\%$, and relative refractive index m between 1.5 and $1.5+i0.5$.

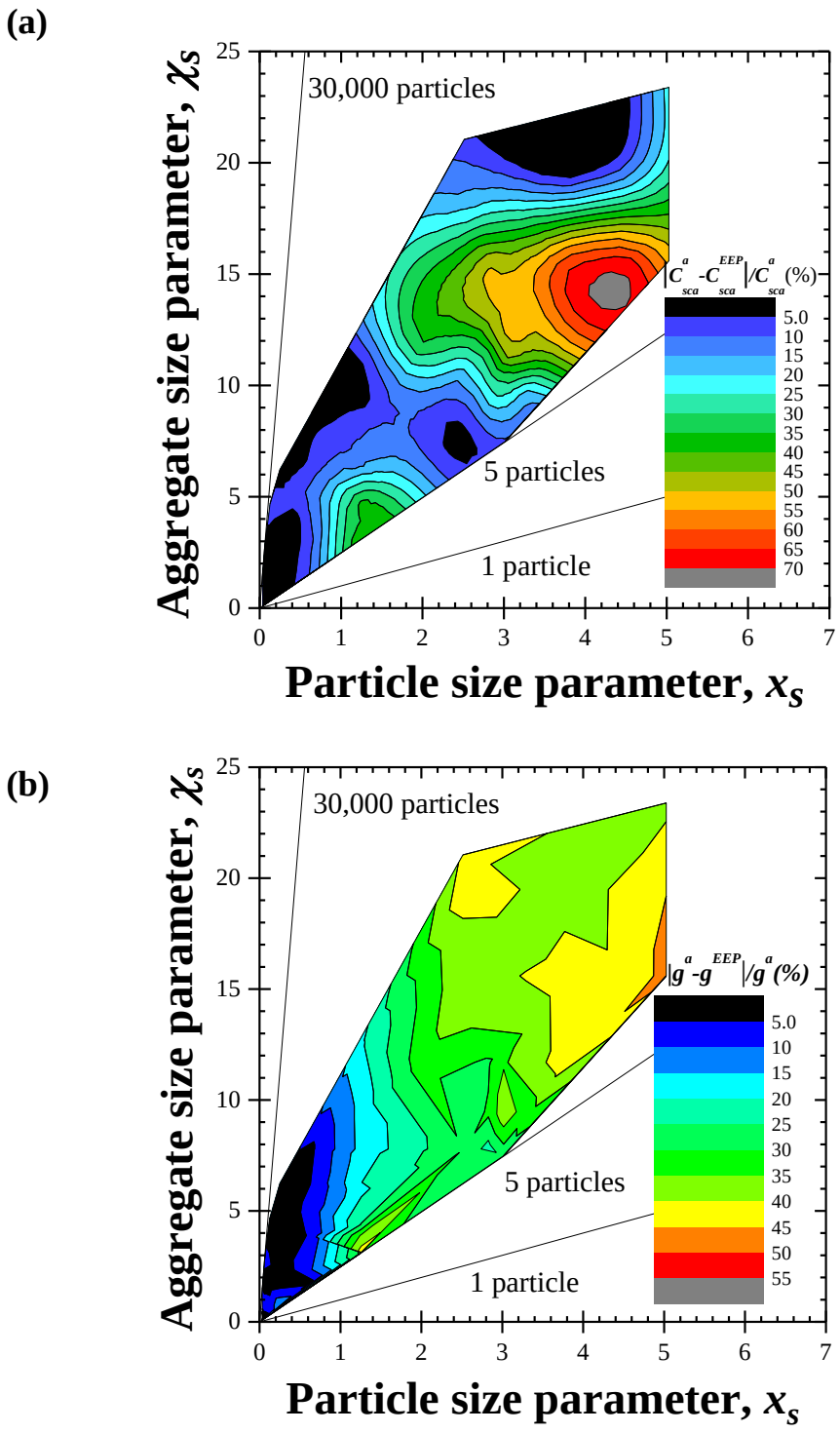

Figure S2: Relative errors (a) $|C^a_{sca}$-$C^{EEP}_{sca}|/C^a_{sca}$ and (b) $|g^a - g^{EEP}|/g^a$ between numerical simulations and EEP approximation predictions for aggregates with particle volume fraction $f_v = 33\pm2\%$ and with point-contact particles with $m = 1.5$ as functions of the particle size parameter x_s and aggregate size parameter χ_s.

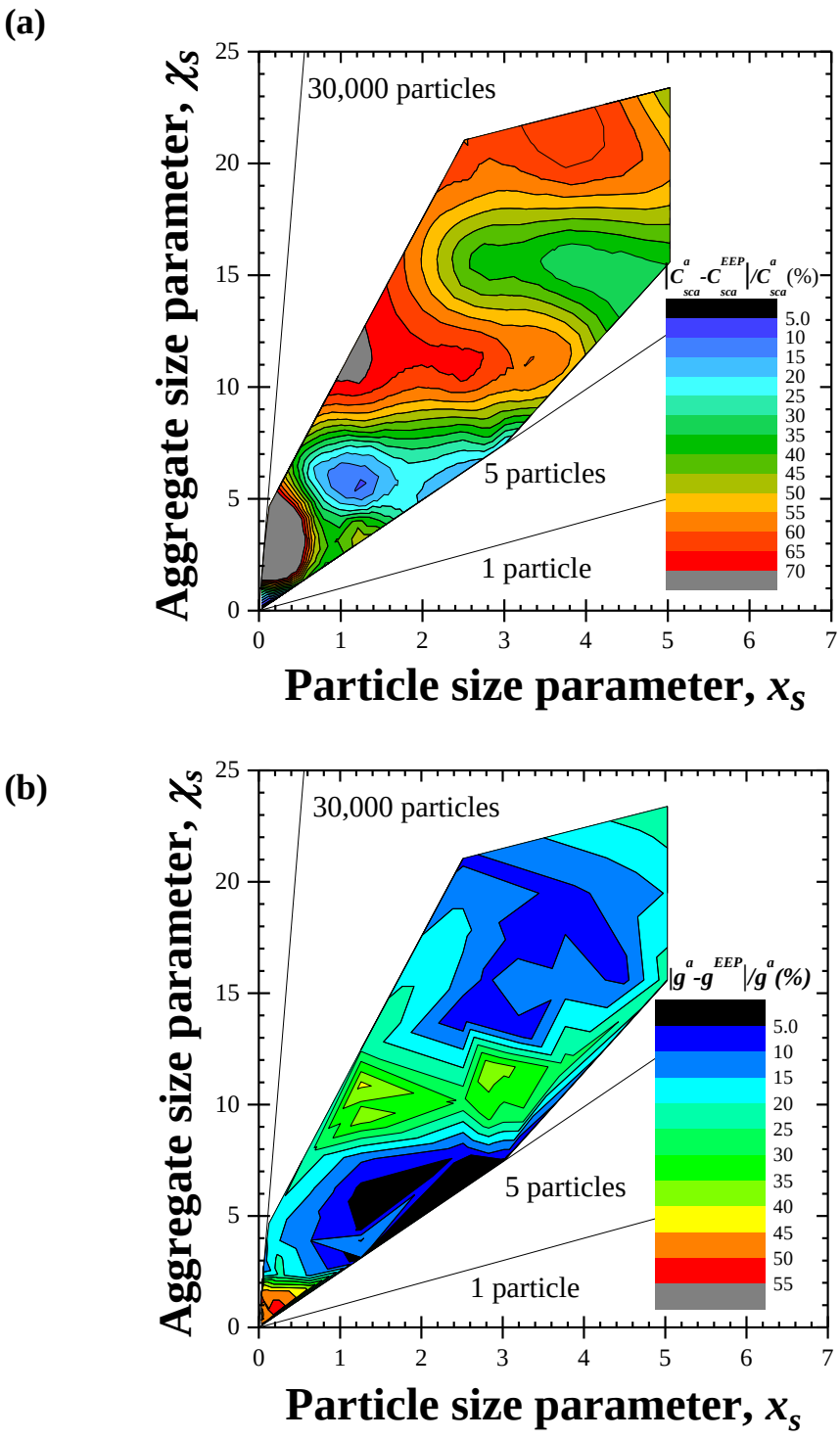

Figure S3: Relative errors (a) $|C^a_{sca}\text{-}C^{EV}_{sca}|/C^a_{sca}$ and (b) $|g^a - g^{EV}|/g^a$ between numerical simulations and EV approximation predictions for aggregates with particle volume fraction $f_v = 33\pm2\%$ and with point-contact particles with $m = 1.5$ as functions of the particle size parameter x_s and aggregate size parameter χ_s.

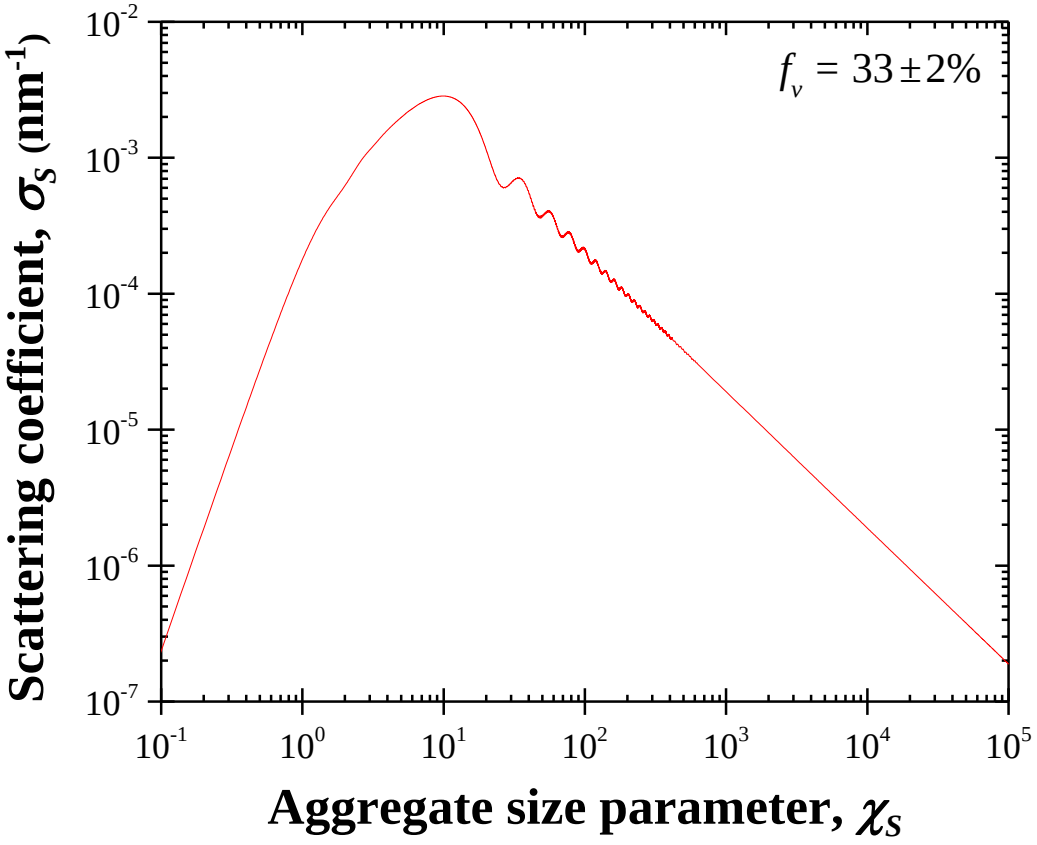

Figure S4: Scattering coefficient σ_s predicted by the EEP approximation for aggregates with $f_v = 33\pm2\%$ and $m = 1.5$ as a function the aggregate size parameter χ_s.

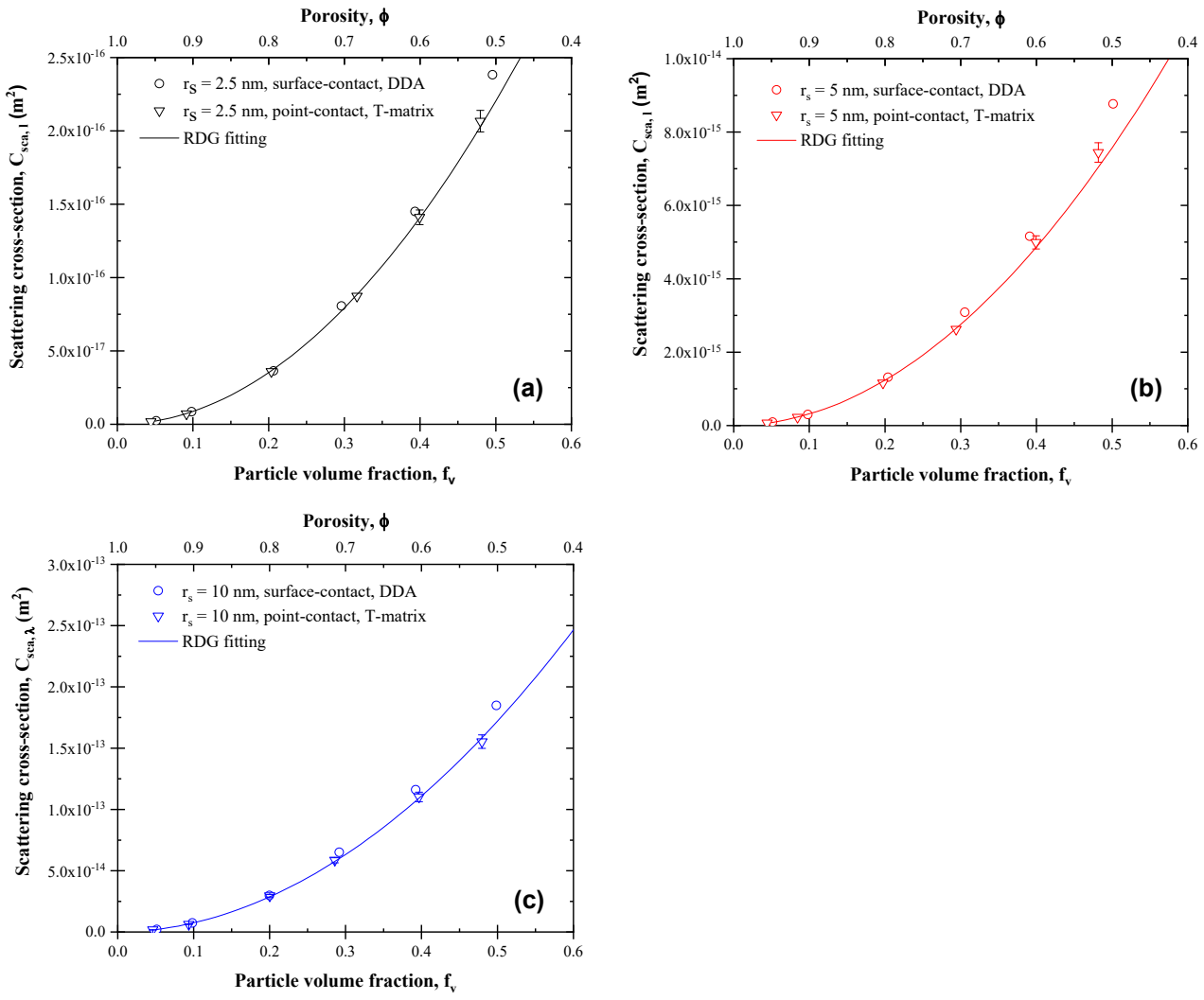

Figure S5: Scattering cross-section of aggregates as a function of aggregate particle volume fraction f_v or porosity ϕ for either point-contact or surface-contact particles with radius r_s = 2.5, 5, and 10 nm.