Diffusion of colloids at liquid-liquid interfaces

Priyanka Sharan[1], Amir Sheikh Shoaei[1], Martin Wittmann[1], Juliane Simmchen[1,2*]
[1]Chair of Physical Chemistry, TU Dresden, 01062 Dresden, Germany
[2]Pure and applied chemistry, University of Strathclyde, G11XL Glasgow

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List of Supporting Videos:

Video S1 : Diffusion of SiO_2 colloids on glass-water interface at 0 wt% and 1 wt% SDS.
Video S2 : Diffusion of SiO_2 colloids on 500 cSt silicone oil-water interface at 0 wt% and 1 wt% SDS.
Video S3 : Diffusion of SiO_2 colloids on 1000 cSt silicone oil-water interface at 0 wt% and 1 wt% SDS.
Video S4 : Diffusion of SiO_2 colloids on 30,000 cSt silicone oil-water interface at 0 wt% and 1 wt% SDS.
Video S5 : Diffusion of SiO_2 colloids on decalin-water interface at 0 wt% and 1 wt% SDS.
Video S6 : Diffusion of SiO_2 colloids on PDMS-water interface at 0 wt% and 1 wt% SDS.

1 Contact angle measurements

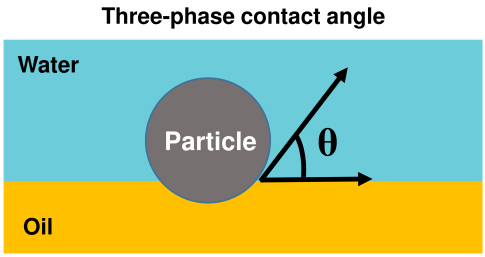

Figure 1: Schematic representation of the three-phase contact angle of a particle adsorbed at water-oil interface

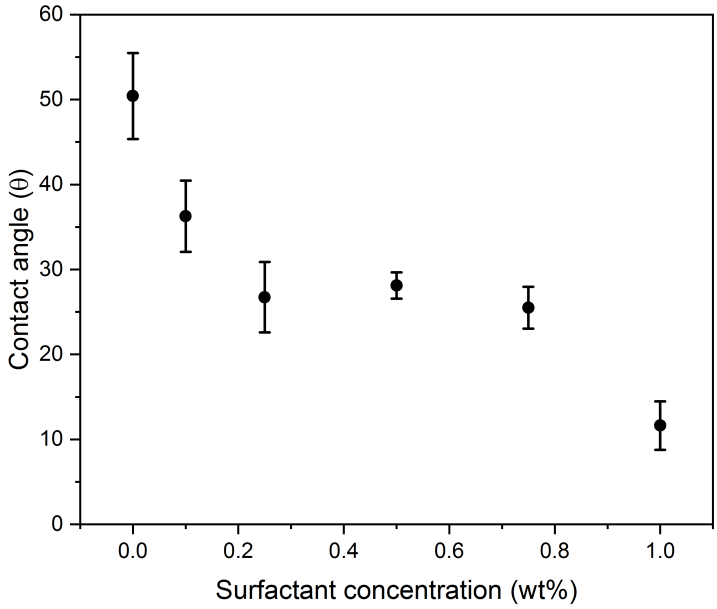

Figure 2: Contact angles of water drops containing varying amounts of SDS surfactant on glass SiO_2 substrate

1.1 Gel trapping method

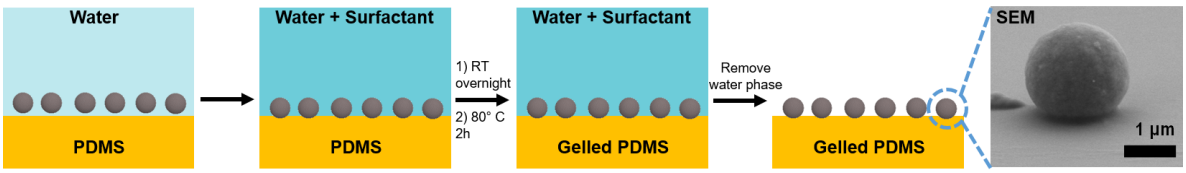

Figure 3: Schematics illustrating gel trapping method to determine the contact angles of colloids at the PDMS-water interface.

1.2 Three-phase contact angle measurement

The particles are primarily immersed in the water phase and loosely attached to the PDMS substrate. Using the tilted (70°) view SEM images of the particles, the diameters of three-phase contact lines, D_c, and the particles' diameter, D, are measured, respectively (Fig 4). The SEM images are analyzed manually with the ImageJ software. Subsequently, the average values of D_c and D are employed to obtain the three-phase contact angle; that is, $\theta = \arcsin(D_c/D)$.

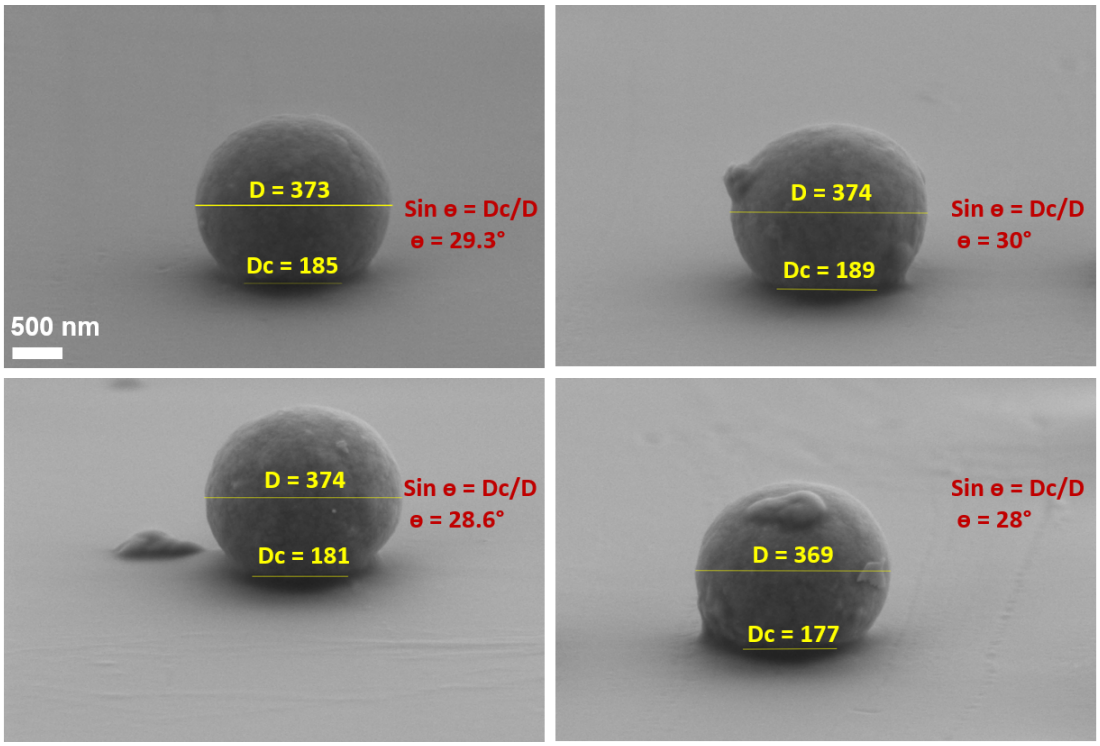

Figure 4: Tilted view SEM images of colloids on the PDMS surface obtained by gel trapping method

1.3 Tilting experiment to examine if particles are trapped at the interface after surfactant addition

After observing particles close/ at the interface, the experimental setup (fluid container) was closed with a homemade glass cap. Subsequently, the container was tilted and observed with the microscope as shown in figure 5. The clear height difference between the oil-water interface makes it possible to verify whether the particles are stuck at the interface (Fig 5a) or they are sedimented close to the bottom glass cap (Fig 5b).

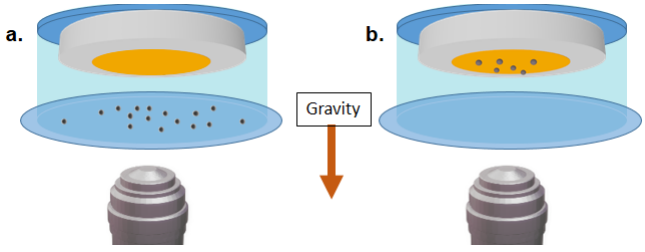

Figure 5: Schematic representation of the tilting experiment. (a) without surfactant, and (b) with surfactant.

2 Surface tension measurements

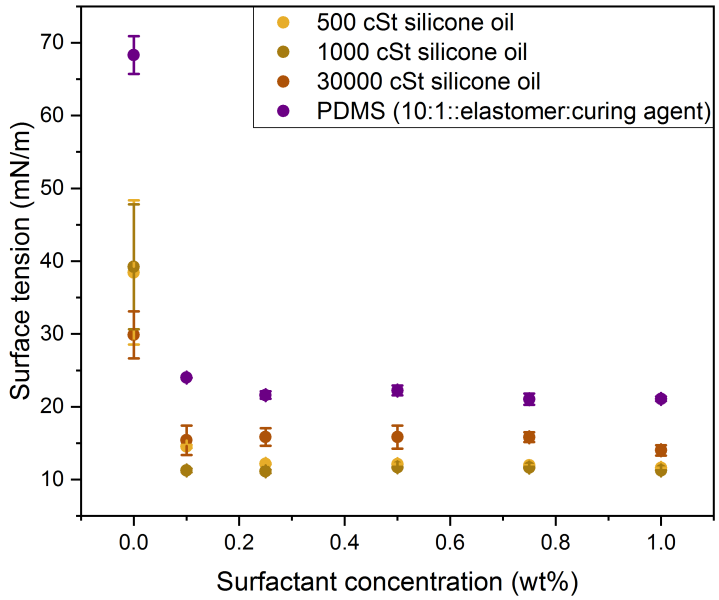

Figure 6: Interfacial tension at the oil-heavy water or PDMS-heavy water interface, with water containing varying surfactant amounts.

3 Diffusion coefficient measurements of SiO_2 colloids at decalin-water interface

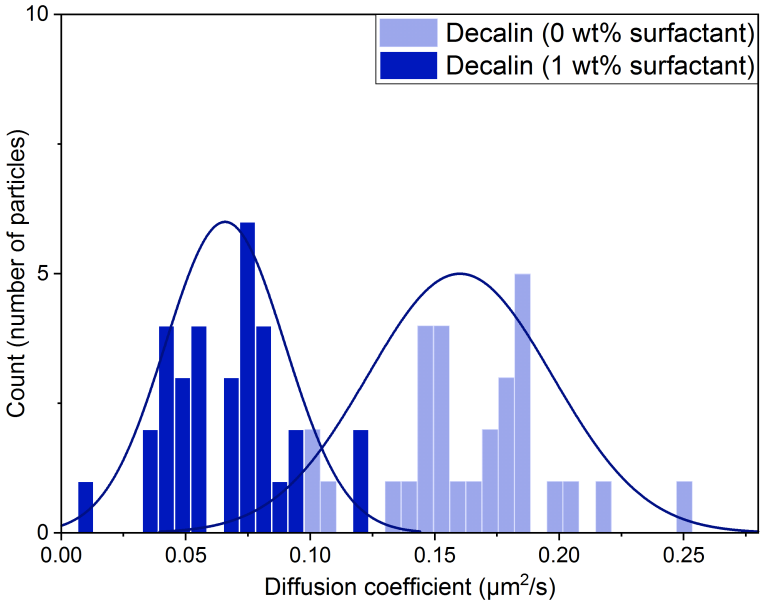

Figure 7: Diffusion coefficient of SiO_2 colloids in no surfactant/surfactant conditions at decalin-water interface.

4 Diffusion coefficient measurements of SiO_2 colloids at PDMS-water interface

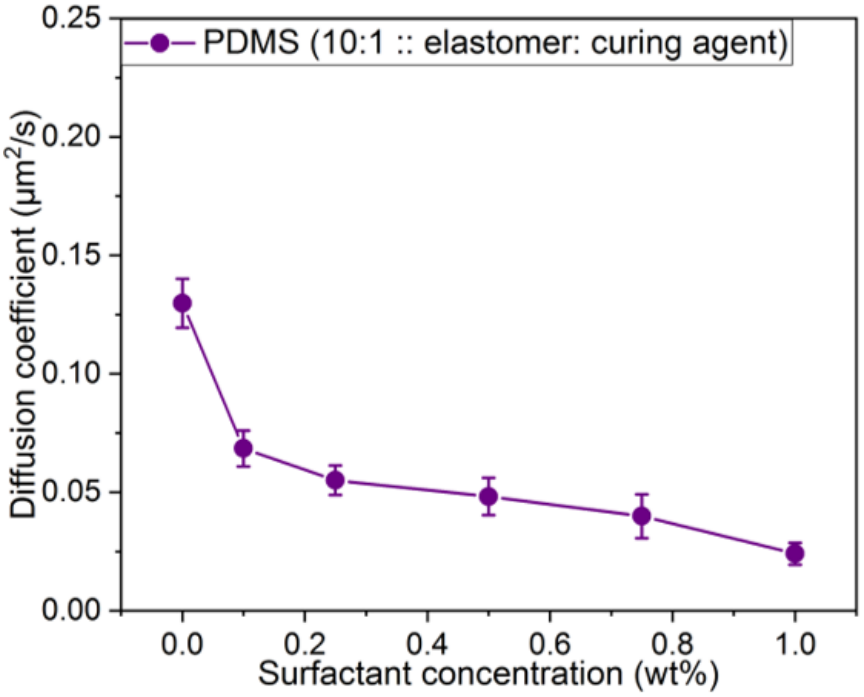

Figure 8: Diffusion coefficients of colloids at PDMS-water interface at varying surfactant concentrations where the PDMS is in non-polymerized state.

5 Interaction of surfactant with colloids

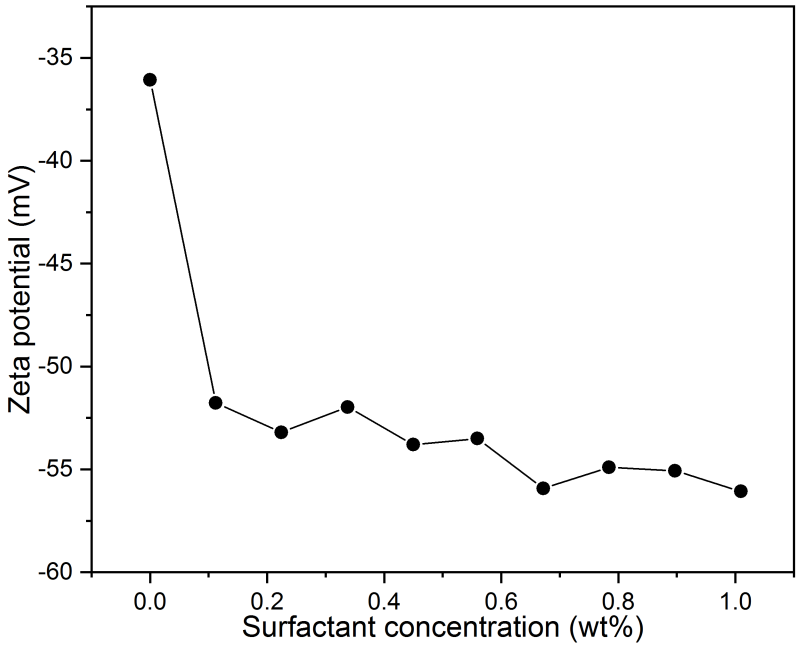

Figure 9: Zeta potential of 2 μm SiO_2 colloids in the presence of different SDS amounts.

6 Mean squared displacement measurements of SiO_2 colloids at glass-water interface

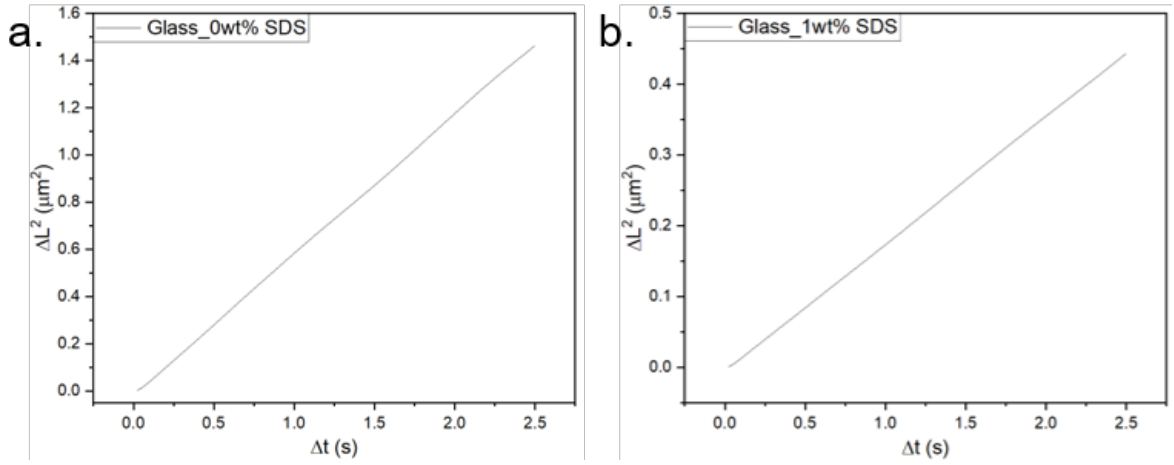

Figure 10: Mean squared displacement measurements of SiO_2 colloids at glass-water interface (a) no surfactant and (b) with 1 wt% surfactant. An average of 10 colloids are taken to plot these graphs.

7 Mean squared displacement measurements of SiO_2 colloids at Silicone oil 500cSt-water interface

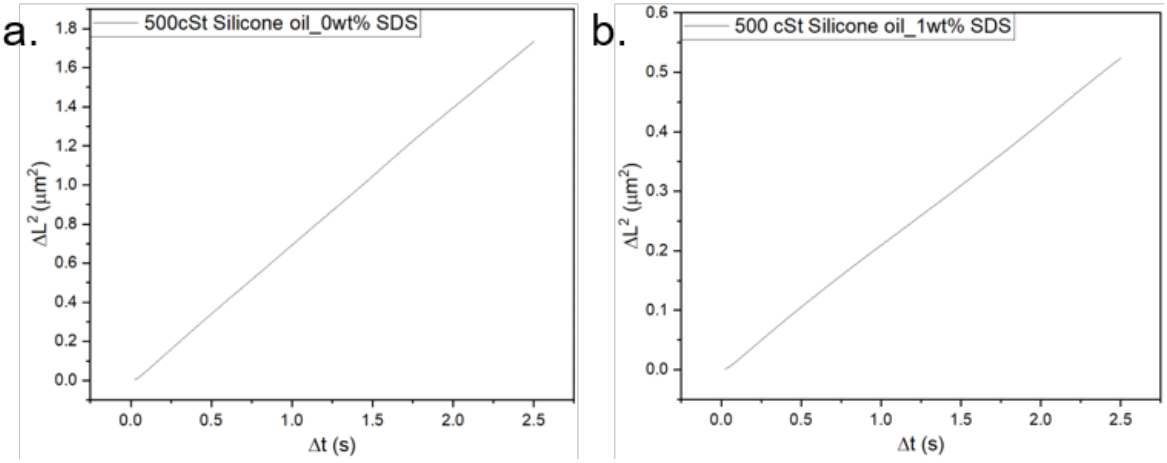

Figure 11: Mean squared displacement measurements of SiO_2 colloids at Silicone oil 500cSt-water interface (a) no surfactant and (b) with 1 wt% surfactant. An average of 10 colloids are taken to plot these graphs.

8 Mean squared displacement measurements of SiO_2 colloids at Silicone oil 1000cSt-water interface

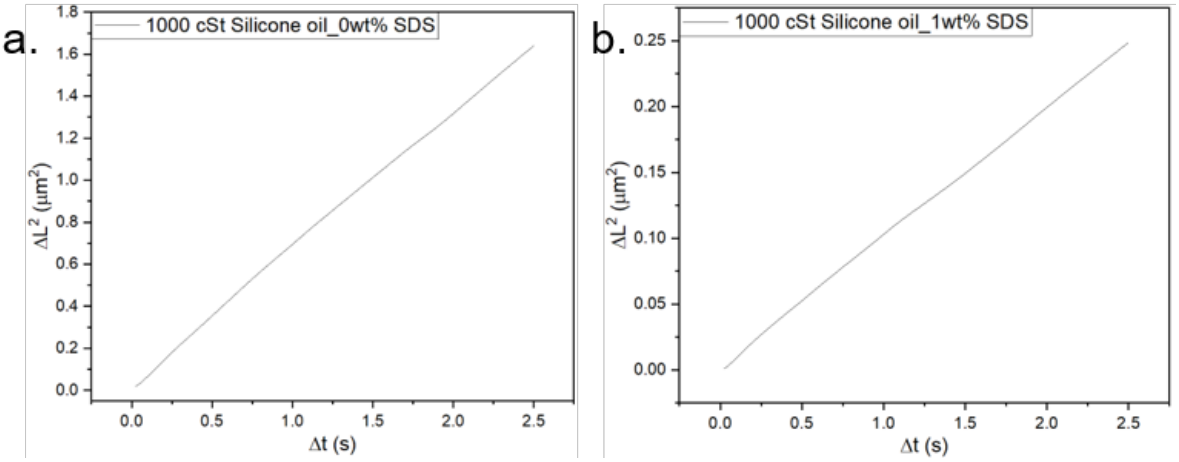

Figure 12: Mean squared displacement measurements of SiO_2 colloids at Silicone oil 1000cSt-water interface (a) no surfactant and (b) with 1 wt% surfactant. An average of 10 colloids are taken to plot these graphs.

9 Mean squared displacement measurements of SiO_2 colloids at Silicone oil 30,000cSt-water interface

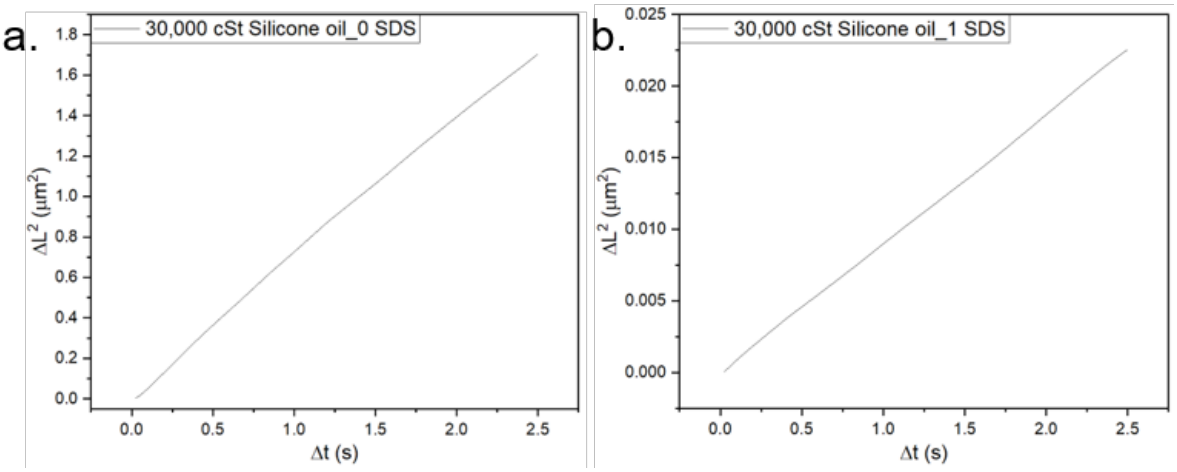

Figure 13: Mean squared displacement measurements of SiO_2 colloids at Silicone oil 30,000cSt-water interface (a) no surfactant and (b) with 1 wt% surfactant. An average of 10 colloids are taken to plot these graphs.

Table 1: Viscosity of the materials used in this study

	Kinematic Viscosity	Dynamic Viscosity at RT	Density
Water	1cSt	1mPa.s	1g/mL
Decalin	3.37cSt	3mPa.s	0.89g/mL
Silicone oil	500cSt	485mPa.s	0.97g/mL
Silicone oil	1000cSt	970mPa.s	0.97g/mL
Silicone oil	30,000cSt	29100 mPa.s	0.97g/mL

References