Measurement methods of interparticles interactions via optical laser tweezers and quantification of their effects on the oil-water interface morphologies

Ha eun, Lee[1]; In Ki, **Hong***;
[1]Skin Care R&D Lab. Kolmar Korea, 61, Heolleung-ro 8-gil, Seocho-gu, Seoul, Republic of Korea
*Skin Care R&D Lab. Kolmar Korea, 61, Heolleung-ro 8-gil, Seocho-gu, Seoul, Republic of Korea

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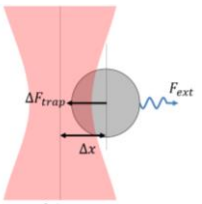
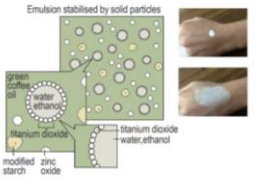
Motivation & Introduction:





Z. Sun, *et al. Particulogy* (2022)

$F_{trap} = k\Delta x$
k : Trap stiffness [pN/μm]
Δx : Displacement from the center of the trap [μm]

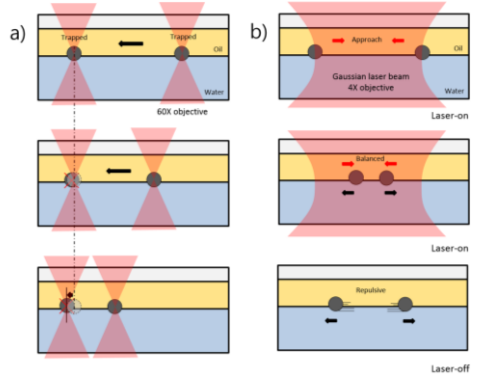
Using optical laser tweezers, interactions between particles could be measured both directly and indirectly depending on their size.

◆ Objective

Introduction of new method to measurement the interparticle interactions: **Trap and release Method**

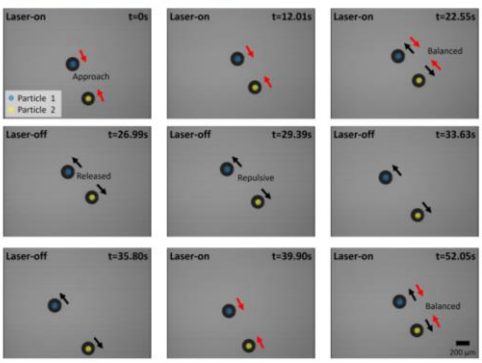
Materials & Methods:

◆ Methods to measure the interactions between particles using optical laser tweezers



a) Direct measurement using highly focused laser beam
b) Trap and release method using low NA objectives

◆ Trap and release method



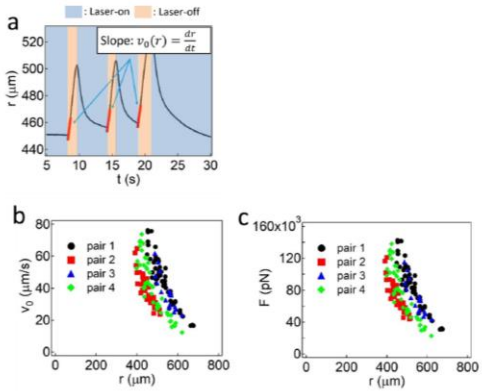
Microscopic images obtained during the migration of two particles upon laser-on and laser-off where the measured laser power was P_{dv} = 100 mW

Results & Discussion:

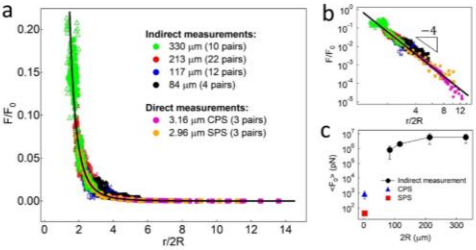
◆ Measurements of the pair interaction

$$F = 6\pi R\eta v\ [pN] \quad \begin{cases} R: \text{ particle radius } [\mu m] \\ \eta: \text{effective viscosity of fluids } [mPa \cdot s] \\ v: \text{ drift velocity of particles } [\mu m/s] \end{cases}$$

$$v = \frac{l}{t}\left[\frac{\mu m}{s}\right] \quad \begin{cases} l: \text{ distance between particles } [\mu m] \\ t: 30 \text{ frames/s} = 30\ [s^{-1}] \end{cases}$$



a) The separation between two particles with time
b) Calculated velocity as a function of separation
c) Calculated net force as a function of separation



a) Repulsive force normalized by F_0 as a function of r/2R.
b) The corresponding log-log plot.
c) Mean magnitude of the interaction force $\langle F_0 \rangle$ as a function of 2R.

Conclusions:

- **Pickering emulsions: emulsions stabilized by solid particles, expended its area in cosmetic products.**
- **Understanding Pickering emulsions' feature and behavior via optical tweezers.**
- **Trap-release method could be employed for indirectly measuring the interparticle interactions for large particles with hundreds dimensions.**
- **The scaling behavior demonstrates that the capillary attractions are negligible, compared to the electrostatic interactions.**