Measuring Retarded Van der Waals Forces using Water Filled Hollow Silica Shells in Total Internal Reflection Microscopy (TIRM)

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Abstract:
Silica particles, in the micro- and nano-metre size scale, is one of the major constituents in particle dispersion applications, such as mineral and ceramic processing, drug delivery systems, pharmaceutical purification, sludge treatment and the manufacture of personal care products, food products and semi-conductors etc. Since the efficiency of all of the above processes is highly governed by the interaction between silica particles, a more fundamental understanding of the forces acting between silica surfaces is essential if significant improvement to process efficiency is desired.

Retarded Van der Waals forces often govern the stability of these systems in suspension, yet conventional force measurement equipments include the Surface Force Apparatus (SFA) and the Atomic Force Microscope (AFM) do not have the appropriate sensitivity to probe such weak forces. Total Internal Reflection Microscopy (TIRM) [Fig. 1] has been shown to be ideal to study these systems using a range of solid particles. In order to gain more insights into the basic fundamentals of forces between two interacting silica surfaces at higher salt concentrations, a hollow silica shell-plate configuration in the TIRM will be used to reduce the long range Van der Waals attraction. Hollow silica shells were synthesized using sol-gel method [Fig. 2] and they were mechanically characterized using the AFM. This presentation aims to discuss some preliminary TIRM results using the synthesized hollow shell-plate configuration.

![Fig. 1](Image)
In TIRM, sphere undergoing vertical Brownian motion in water is illuminated by the evanescent wave generated due to total internal reflection at the glass prism. The potential energy of the sphere is then deduced by measuring its scattering intensity over time.

![Fig. 2](Image)
Hollow Silica Shells synthesized using solid polystyrene cores (Core Size = 4.9\textmu m, Shell Thickness = 40nm)