PICKERING EMULSIONS USING A FUMED SILICA AND A SILICA SOL – THE EFFECT OF MICROFLUIDIZATION

Isabel Mira[1], Karin Persson[1] Bernard P Binks[2]
1 RISE Research Institutes of Sweden
2 Department of Chemistry and , University of Hull
Contact Email: karin.persson@ri.se

Abstract Text

The ability of colloidal silica to stabilize nano-oil-in-water emulsions prepared using a Microfluidizer® has been demonstrated by Persson, K.H., Blute, I.A., Mira, I.C., Gustafsson, J. Creation of well-defined particle stabilized oil-in-water nanoemulsions, 2014, Colloids and Surfaces A: Physicochemical and Engineering Aspects, 459, pp. 48-57.

As vast amount of work has been performed and reported on fumed silica-stabilized emulsions, we wanted to investigate the limiting emulsion droplet size that can be obtained with these by means of emulsification via microfluidization in a Microfluidizer®.

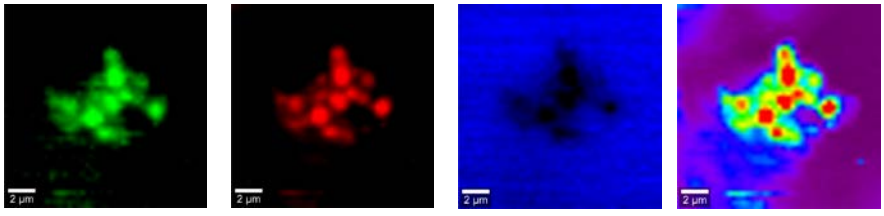
In our work we used fumed silica with 80%SiOH and a primary particle diameter of 25-30 nm. Fumed silica is known to partially fuse into larger 'aggregates'. A colloidal silica Levasil CC301 (7 nm particle diameter) was used as benchmark.

The results show that both fumed and colloidal silica particles stabilize squalene-in-water emulsions with 10% w oil . Emulsions produced with Levasil CC301 were characterized by a droplet size of 0.092 µm (volume mean diameter) . No variations in droplet size were observed for at least a month (previous work indicates that these type of emulsions remain stable for years).

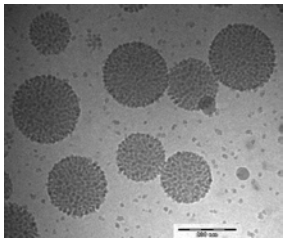
However, while the fumed silica also stabilize 10% squalene-in-water emulsions, the mean droplet size of these emulsions is larger (2-10 µm), and the droplets grow in size with time. Using less oil (5%) and pre-dispersing the fumed silica in the Microfluidizer® results in more stable emulsions. This emulsion initially has a bimodal droplet size distribution but the droplets coalesce (or agglomerate) resulting in an emulsion with stable droplet size of 3-20 µm. This droplet size was constant between 1 week and 1 month.

In summary, while the fumed silica is good for stabilization of emulsions with droplets sizes larger than 2 µm, it is not suitable for stabilization of nano-oil-in-water emulsions. Surface-modified colloidal silica performs very well as stabilizers of nano-oil-in-water-emulsions.

Silica Squalene Water Combined



Confocal Raman Microscopy images of the 10%w squalene emulsion stabilized with fumed silica. The images show (from left to right) the location of: silica, squalene, water and all the components at once. Scale bar: 2 µm.



CRYO-TEM of 5% oil nano emulsion stabilized with colloidal silica. The scale bar is 200 nm.

Back to Programme