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APPENDICES

APPENDIX A
EXPERIMENTAL DATA

Phase diagram of DP6/heptane/water system with and without the presence of butanol has been shown as following:

Without adding butanol		
%DP6	**%Heptane**	**%H_2O**
2.1880	97.8120	0.0000
2.8776	96.0027	0.8665
5.6876	92.9930	1.0692
7.0605	91.4178	1.2732
8.4236	89.9585	1.3708
9.7403	88.2395	1.7752
11.0454	86.6402	2.0714
13.5956	83.5149	2.6502

[Butanol] = 0.0161 M		
%DP6	**%Heptane**	**%H_2O**
2.1841	97.6393	0.0000
2.8726	95.8355	0.8650
5.6718	92.7344	1.1723
7.0262	90.9736	1.5825
8.3741	89.4305	1.7806
9.6937	87.8171	2.0776
10.9929	86.2286	2.3700
13.5320	83.1242	2.9416

[Butanol] = 0.1061 M		
%DP6	**%Heptane**	**%H_2O**
2.1625	96.6723	0.0000
2.8354	94.5971	1.1721
5.5877	91.3598	1.6776
6.9302	89.7299	1.9757
8.2434	88.0347	2.3697
9.5241	86.2809	2.8558
10.8021	84.7317	3.1373
13.2742	81.5405	3.8789

APPENDIX B
CALCULATION OF THE SYNTHESIZED SILICA-PARTICLE NUMBER

This section is to categorize the general calculation of the number of silica particles in microemulsion solution by using the mass balance of TBOS and the diameter of particle. The concentration of TBOS at various stages were observed from the evolution of FTIR spectra by calibrating the absorbance of TBOS. Likewise, the evolution micrographs of silica particle size at different reaction period were measured with the View capture apparatus and using TEM.

The number of silica particles (N_P) is calculated as follows:

Where <D> is defined as the average diameter of silica particle.

The volume for one particle (Vp, ml) is:

$$V_p = \frac{4}{3}\pi\left(\frac{\langle D\rangle}{2}\right)^3 \tag{B.1}$$

$$= \frac{\pi}{6}\langle D\rangle^3 \tag{B.2}$$

The density of silica particle (d_P, g/ml) is approximated of 2.09 (Arriagada, 1991)

The contained mass of one particle (M_P, g) is:

$$M_P = \frac{\pi}{6}\langle D\rangle^3 \times d_P \tag{B.3}$$

Overall used mass of TBOS at time t (M_{TBOS}, g) is:

$$M_{TBOS} = m^o_{TBOS} - m^\infty_{TBOS} \tag{B.4}$$

where m^{o}_{TBOS} is the mass of TBOS at the initial stage and m^{∞}_{TBOS} is the mass of TBOS at the reaction time t.

Assuming all of used amount of TBOS can completely change to form silica particles, eventually. Therefore, the number of silica particle (N_P) is:

$$N_P = \frac{M_{TBOS}}{M_P} \tag{B.5}$$

APPENDIX C

CALCULATION OF AVERAGE DIAMETER <D> AND NORMALIZED STANDARD DEVIATION (σ/<D>)

The values of <D> and (σ/<D>) can indicate the approximately dimension and particle size distribution of silica particle formed. Since synthesized silica particles as spherical shape were measured by using View Capture and TEM micrographs enlarged. The diameter of 200 silica particles was observed for better correctly results. For example of calculation of these values can be shown as follows:

This example bases on the experiment of controlling the silica particles formation using butanol (Figure 4.10). Table C.1 shows the collected diameter (D) of 200 silica particles that observed from TEM micrographs. The unit of diameter was rescaled to be nanometer dimension. The average diameter <D> of silica particles formed is

$$\langle D \rangle = \frac{\sum D}{n} \qquad \text{(C.1)}$$

Where n as the number of population is 200 for this calculation.

From equation C.1 and the above data, thus, the computed value of <D> is 39.4737 nm.

The squared diameter of silica particle $<D^2>$ is in table C.2 and then the averaged value $<D^2>$ is 1576.24. The standard deviation can be calculated following equation 3.1.

$$\sigma = \left[\langle D^2 \rangle - \langle D \rangle^2 \right]^{\frac{1}{2}} \qquad \text{(3.1)}$$

Table C.1 Rescaled diameter of 200 sampled particles

D (nm)							
39.4737	39.4737	40.7895	39.4737	39.4737	38.1579	38.1579	38.1579
40.7895	40.7895	40.7895	40.7895	39.4737	38.1579	40.7895	40.7895
39.4737	40.7895	40.7895	39.4737	38.1579	38.1579	40.7895	39.4737
39.4737	39.4737	39.4737	39.4737	39.4737	40.7895	40.7895	39.4737
39.4737	39.4737	39.4737	40.7895	39.4737	39.4737	40.7895	40.7895
40.7895	39.4737	40.7895	38.1579	39.4737	39.4737	39.4737	40.7895
39.4737	40.7895	38.1579	39.4737	39.4737	39.4737	40.7895	39.4737
39.4737	39.4737	40.7895	38.1579	39.4737	39.4737	40.7895	39.4737
40.7895	39.4737	39.4737	40.7895	40.7895	39.4737	40.7895	39.4737
39.4737	39.4737	38.1579	40.7895	39.4737	39.4737	40.7895	39.4737
39.4737	40.7895	38.1579	40.7895	38.1579	39.4737	40.7895	39.4737
39.4737	38.1579	38.1579	39.4737	39.4737	39.4737	39.4737	39.4737
39.4737	38.1579	39.4737	40.7895	39.4737	39.4737	40.7895	39.4737
39.4737	38.1579	39.4737	40.7895	39.4737	39.4737	39.4737	39.4737
39.4737	38.1579	38.1579	40.7895	39.4737	40.7895	40.7895	39.4737
39.4737	38.1579	38.1579	40.7895	39.4737	40.7895	40.7895	40.7895
38.1579	39.4737	38.1579	40.7895	39.4737	40.7895	40.7895	40.7895
39.4737	39.4737	38.1579	40.7895	39.4737	40.7895	40.7895	40.7895
39.4737	39.4737	38.1579	40.7895	39.4737	40.7895	40.7895	40.7895
39.4737	39.4737	38.1579	40.7895	39.4737	40.7895	40.7895	40.7895
39.4737	39.4737	38.1579	40.7895	39.4737	40.7895	40.7895	40.7895
39.4737	39.4737	38.1579	40.7895	38.1579	40.7895	40.7895	38.1579
39.4737	39.4737	39.4737	39.4737	39.4737	40.7895	38.1579	38.1579
39.4737	38.1579	40.7895	38.1579	39.4737	40.7895	40.7895	38.1579
39.4737	38.1579	40.7895	39.4737	39.4737	40.7895	38.1579	38.1579

Table C.2 Squared diameter of 200 sampled particles

D^2							
1558.17	1558.17	1663.78	1558.17	1558.17	1558.17	1558.17	1558.17
1663.78	1663.78	1663.78	1663.78	1558.17	1558.17	1663.78	1558.17
1558.17	1663.78	1663.78	1558.17	1558.17	1558.17	1558.17	1558.17
1558.17	1558.17	1558.17	1558.17	1558.17	1663.78	1663.78	1558.17
1558.17	1558.17	1558.17	1663.78	1558.17	1663.78	1663.78	1663.78
1663.78	1558.17	1663.78	1456.02	1558.17	1663.78	1663.78	1663.78
1558.17	1663.78	1456.02	1558.17	1558.17	1663.78	1663.78	1663.78
1558.17	1558.17	1663.78	1456.02	1558.17	1663.78	1663.78	1663.78
1663.78	1558.17	1558.17	1663.78	1558.17	1663.78	1663.78	1663.78
1558.17	1558.17	1456.02	1663.78	1558.17	1663.78	1663.78	1663.78
1558.17	1663.78	1456.02	1663.78	1456.02	1663.78	1663.78	1456.02
1558.17	1456.02	1456.02	1558.17	1558.17	1663.78	1456.02	1456.02
1558.17	1456.02	1558.17	1663.78	1558.17	1663.78	1663.78	1456.02
1558.17	1456.02	1558.17	1663.78	1558.17	1663.78	1456.02	1456.02
1558.17	1456.02	1456.02	1663.78	1558.17	1456.02	1456.02	1663.78
1558.17	1456.02	1456.02	1456.02	1456.02	1558.17	1456.02	1663.78
1558.17	1456.02	1663.78	1663.78	1558.17	1558.17	1456.02	1663.78
1456.02	1456.02	1663.78	1558.17	1558.17	1558.17	1456.02	1663.78
1558.17	1663.78	1663.78	1558.17	1558.17	1558.17	1456.02	1663.78
1558.17	1558.17	1663.78	1663.78	1558.17	1558.17	1456.02	1663.78
1558.17	1558.17	1558.17	1663.78	1558.17	1558.17	1456.02	1663.78
1558.17	1558.17	1663.78	1558.17	1558.17	1558.17	1558.17	1558.17
1558.17	1558.17	1663.78	1558.17	1558.17	1456.02	1663.78	1456.02
1663.78	1558.17	1663.78	1558.17	1558.17	1456.02	1663.78	1558.17
1558.17	1558.17	1663.78	1558.17	1456.02	1558.17	1663.78	1558.17

Thus, the σ calculated is 0.9376 and the normal standard deviation (σ/ <D>) is 0.0236. This value has been located at 3rd point of Figure 4.10 that shown as the percentage value (2.36 %).

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