Pseudo-solid, shear-thinning gel formation in binary dispersions of metal oxide nanoparticles at low volume fractions

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SUPPORTING INFORMATION

a.

b.

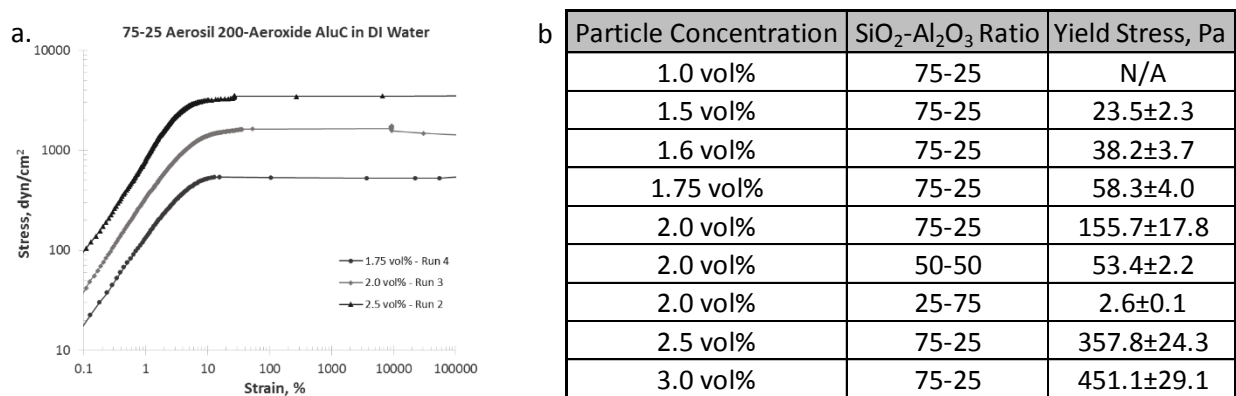| Particle Concentration	SiO$_2$-Al$_2$O$_3$ Ratio	Yield Stress, Pa
1.0 vol%	75-25	N/A
1.5 vol%	75-25	23.5±2.3
1.6 vol%	75-25	38.2±3.7
1.75 vol%	75-25	58.3±4.0
2.0 vol%	75-25	155.7±17.8
2.0 vol%	50-50	53.4±2.2
2.0 vol%	25-75	2.6±0.1
2.5 vol%	75-25	357.8±24.3
3.0 vol%	75-25	451.1±29.1

Figure 1 (SI): Three examples of stress-strain curves obtained during a yield stress experiment on the gels (a.) and a table of yield stress values for gels with a variety of particle ratios and particle concentrations (b.) All samples were tested at solution pH = 7

Yield stresses were measured using an SR-5000 rheometer (cone and plate geometry) by running a stress ramp experiment and measuring the sample strain (%), the yield stress was defined as the point where plastic deformation of the sample begins (stress-strain curve levels off), as seen in Figure 1 (SI) a.). Each yield stress value in the table (Figure 1 (SI) b.)was determined by averaging a minimum of four independent experiments, with the listed ± value representing the standard deviation between the separate experiments. No major issues with wall-slip were encountered during these experiments. Experiments have also been completed to measure the compressive yield stress (stress required to compress the gel network, leaving a clear, aqueous supernatant above, results still being interpreted) and are currently conducting frequency sweep tests to measure G'/G" values for the gel samples (these results are currently on hold due to maintenance on our strain-controlled rheometer).

The "fraction of a second" relaxation time mentioned in the results and discussion section is based on direct observation that the gels do not exhibit any noticeable 'setting' time required to regain their pseudo-solid characteristics. Further investigations will be made using a strain-controlled rheometer and this information will be included in a rheology-focused article; however given the rapidity of the recovery such experiments man not be fruitful.

Below are two G'/G" vs. frequency plots for a 75-25 Aerosil 200-Aeroxide Alu C gel with a total particle concentration of 2.0 vol%. Data was gathered using a Rheometrics Scientific RSA II dynamic mechanical analyzer.