

Supplementary information

# Processing method determines the long-term stability of particle dispersions in concentrated nanoparticle/polymer suspensions

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## **1. Sample preparation – residual ethanol**

### 1) In the water-based silica particle solution

Gas chromatography (GC) was used to confirm the amount of residual ethanol in water-based silica particle solution after the solvent exchange process. First, we identified the peak position of pure ethanol and water, respectively. Next, we measured GC data of the water-based silica particle solution after the solvent exchanging process. By calculating the areal fraction of peak attributed to ethanol solvent in the water-based silica particle solution, we confirmed the amount of residual ethanol is less than 0.6%. [1]

### 2) In the sample of ‘M2-melt dilution’

As we described in Section 2.2 in the main text, PEG chains, and silica particles are firstly mixed in ethanol solvent for ‘M2-melt dilution’. We evaporated and removed ethanol solvent in a vacuum oven at 70 °C until no further mass loss is found. The FT-IR data of PNCs produced with the same condition of ‘M2-melt dilution’ removing the initial solvent of ethanol [1] shows that no residual ethanol was left.

## 2. $P(q)$ , form factor model fit

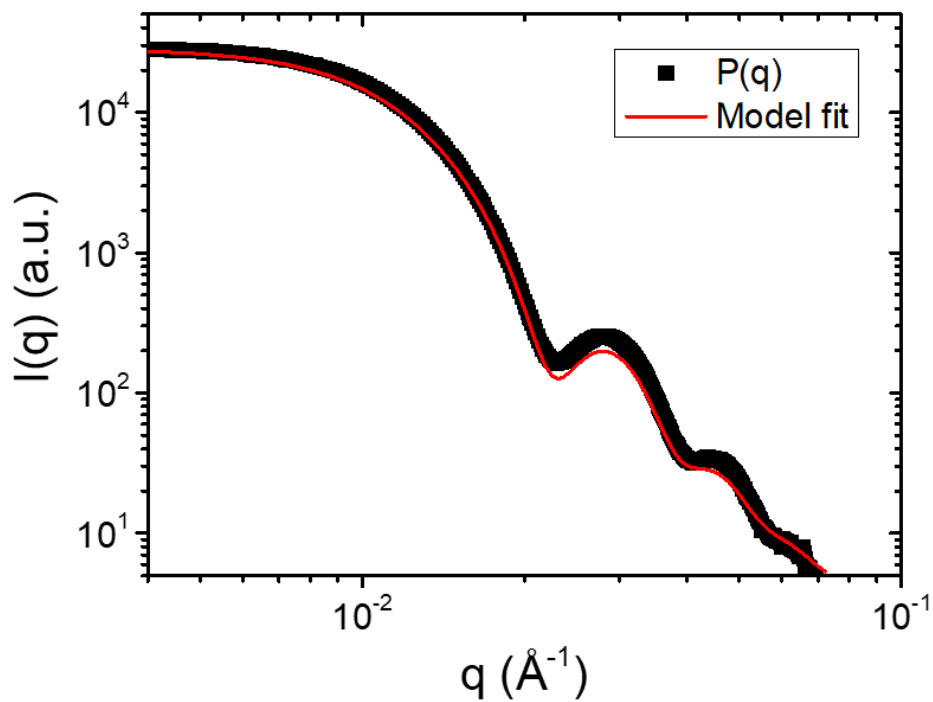


Fig. S1 The experimentally scattered intensity of particle form factor,  $P(q)$ , (black symbol) are fitted by assuming Log-normal distribution. The fitting results are displayed by red solid line. The average diameter of nanoparticle is found to be around 39.4 nm with 10.9% of standard deviation.

### 3. $I(q)$ – Hard sphere model fit

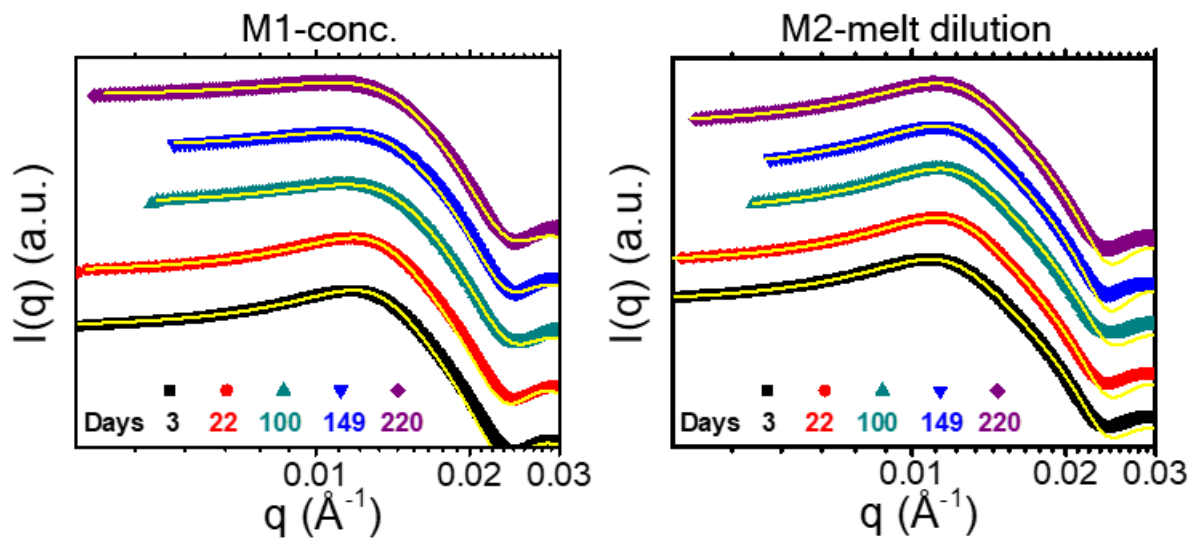


Fig. S2 The small-angle X-ray scattering (SAXS) intensities of the concentrated suspension,  $I(q)$ , with PEG 3.35 kg/mol are fitted by hard sphere model. The fitting results are displayed with yellow solid lines. For clarity, the profiles are vertically shifted. The  $R_p$  is 0.5 and  $\phi_c$  is 0.2.

#### 4. Surface coverage rate and polymer desorption rate

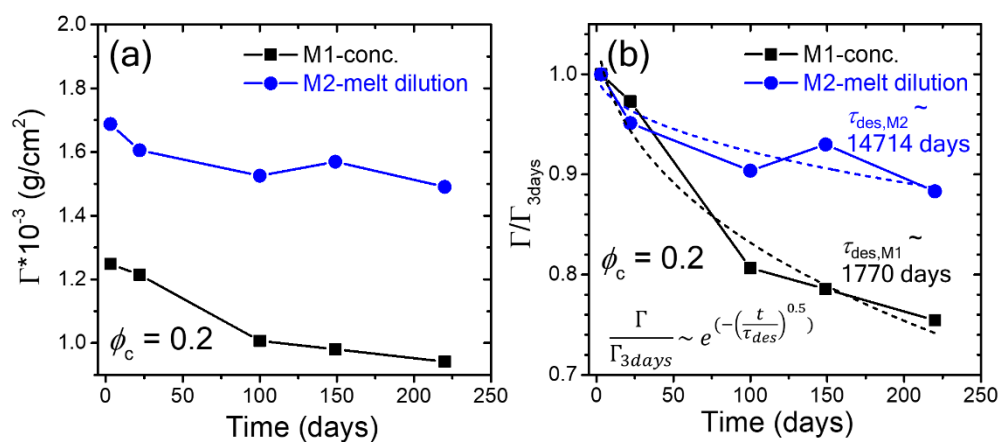


Fig. S3 The (a) surface coverage,  $\Gamma$ , and (b)  $\Gamma$  normalized by the initial surface coverage at 3 days of aging time,  $\Gamma_{3days}$ , is plotted as a function of aging time. The black square and blue circle symbols represent the result of ‘M1-conc.’ and ‘M2-melt dilution’, respectively. The dashed lines indicate the result of fitting by using the stretched exponential decay equation.

## References

- [1] S. M. Oh, M. Abbasi, T. J. Shin, K. Saalwächter and S. Y. Kim, *Phys. Rev. Lett.*, 2019, **123**, 167801.