Seeded Growth of Titania Colloids with Refractive Index Tunability and Fluorophore-free Luminescence

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Static light scattering curves for the titania particles used in video-holography measurements are shown in Fig. S1. These particles were further grown by using amorphous titania seeds of 950 nm size.
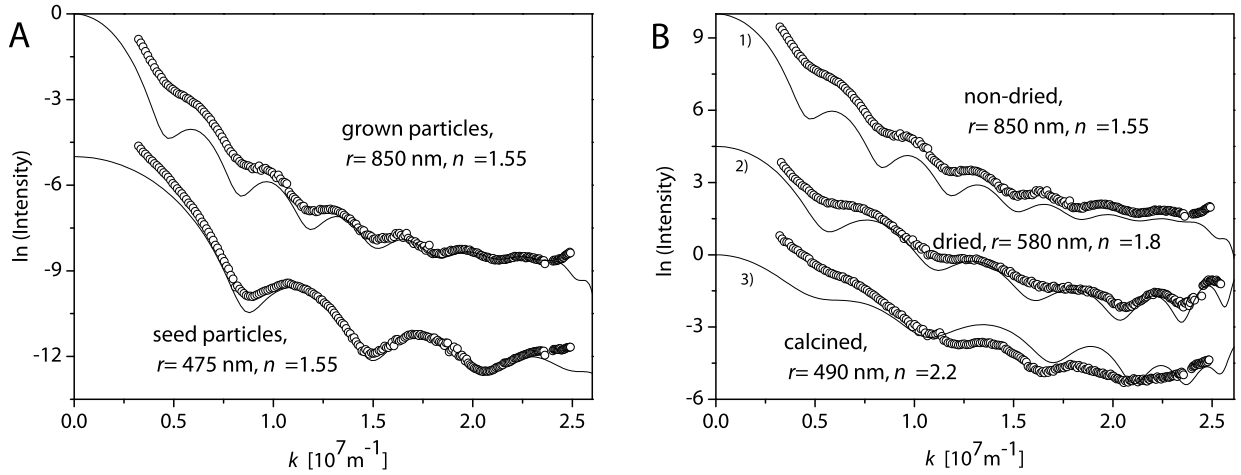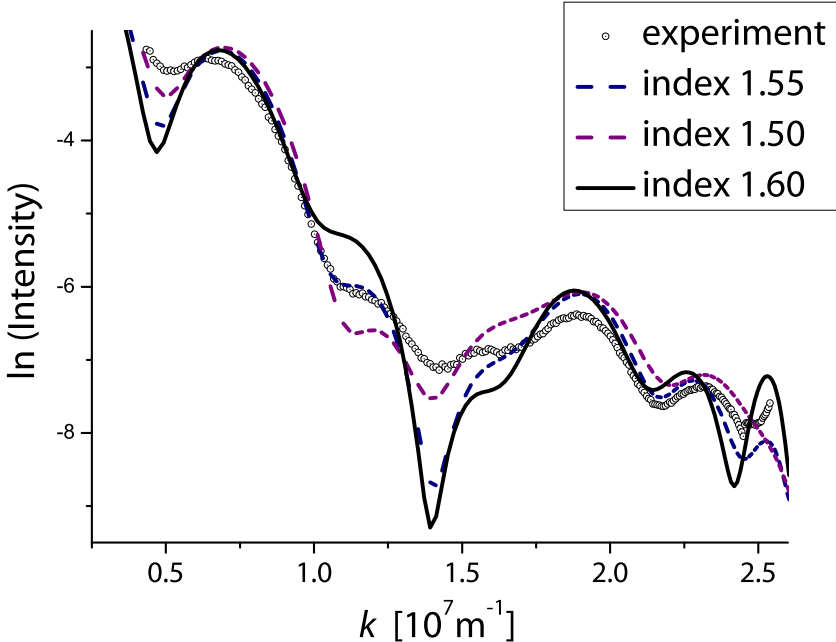

Figure S1. Static light scattering (SLS) experimental curves of the titania particles (symbols) in ethanol fitted to theoretical calculations of the full Mie solutions to the form factor (lines, offset for clarity). For the Mie solutions the polydispersity of the particles was assumed to be 5 % and for all graphs. Radii (r)and refractive indices (n) are shown on the graphs. (a) SLS curves for amorphous titania seeds before and after growth, (b) These grown titania particles non-dried (1), dried (2) and calcined at 450 °C for 1h (3). The SLS determination of the refractive indices for the non-dried, dried and calcined particles agree very well with the values found by holography method (k = scattering vector).

These amorphous seeds were synthesized according to the procedure of Yu *et al.*[1] and the growth was

performed as described in the article. In Table S1 (below) the assigned sizes and refractive indices by different techniques are tabulated. Note that digital-holography method is a single-particle method and here size is determined only for a single particle.

Table S1. Diameter from TEM and SLS of the particles in Fig. S1. refractive indices by holography method are compared with the ones of SLS. Polydispersities are given in parentheses.

Particles (Fig. no)	S1b(1)	S1b(2)	S1b(3)
TEM size [nm]	-	-	975 (4%)
SLS size [nm]	1700 (5%)	1160 (5%)	980 (5%)
Holography size [nm]	1804	1332	1106
SLS η	1.55	1.8	2.2
Holography η	1.55	1.87	2.2

Figure S2. SLS experimental curves of the titania particles (symbols) in ethanol fitted to theoretical calculations of the full Mie solutions to the form factor. Dried core-shell particles given in Fig. 3(c) and three different Mie solutions to the experimental data to give an idea about the accuracy of the refractive index assignment with SLS technique. These calculations with ± 0.05 refractive index change differs from the experimental curve and cannot match the minima. (k = scattering vector).

Figure S2. demonstrates that the minima for the experimental curve matches the simulation curves best for the refractive index 1.55. The simulation curve for refractive index 1.5 is off in some minima but

especially it can not reproduce the last oscillation around k=2.5 $\times$ 10^7, which means that the index should be higher than 1.50. On the other hand simulations for the refractive index 1.60 results in off positioned deeper minima, which is a sign of lower index. These curves proves that the technique estimates the refractive index with a $\pm$0.05 accuracy.
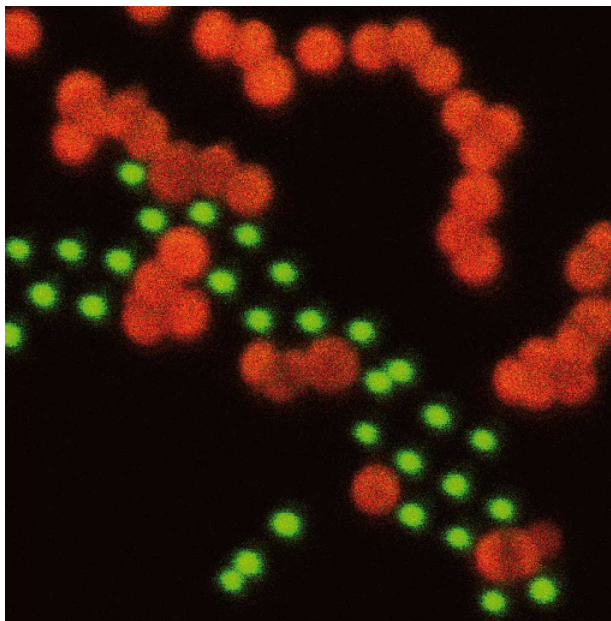
Figure S3. Confocal fluorescence microscopy image of a mixture of FITC labeled silica particles and APS incorporated and calcined titania particles(APS content is 0.5 μL per 0.65 mL of TBT. Particles were dried on a microscope slide for the imaging. [image size (a) = 7 μm $\times$ 7 μm].

Figure S3. is a confocal fluorescence microscopy image of a mixture of FITC labeled silica particles and APS incorporated and calcined titania particles to compare the fluorescence of these particles and to show the availability of the APS-titania particles for practical use.

References

[1] Yu, H. K.; Yi, G. R.; Kang, J. H.; Cho, Y. S.; Manoharan, V. N.; Pine, D. J.; Yang, S. M. *Chem. Mater.* **2008**, *20*, 2704–2710.