Supplementary Materials

Surface functionalization of magnetic nanoparticles using a thiol-based grafting through approach

Philip Biehl, F. H. Schacher

Institute of Organic and Macromolecular Chemistry (IOMC), Friedrich Schiller University Jena, Humboldtstraße 10, D-07743 Jena, Germany

E-mail: felix.schacher@uni-jena.de

Jena Center for Soft Matter (JCSM), Friedrich Schiller University Jena, Philosophenweg 7, D-07743 Jena, Germany

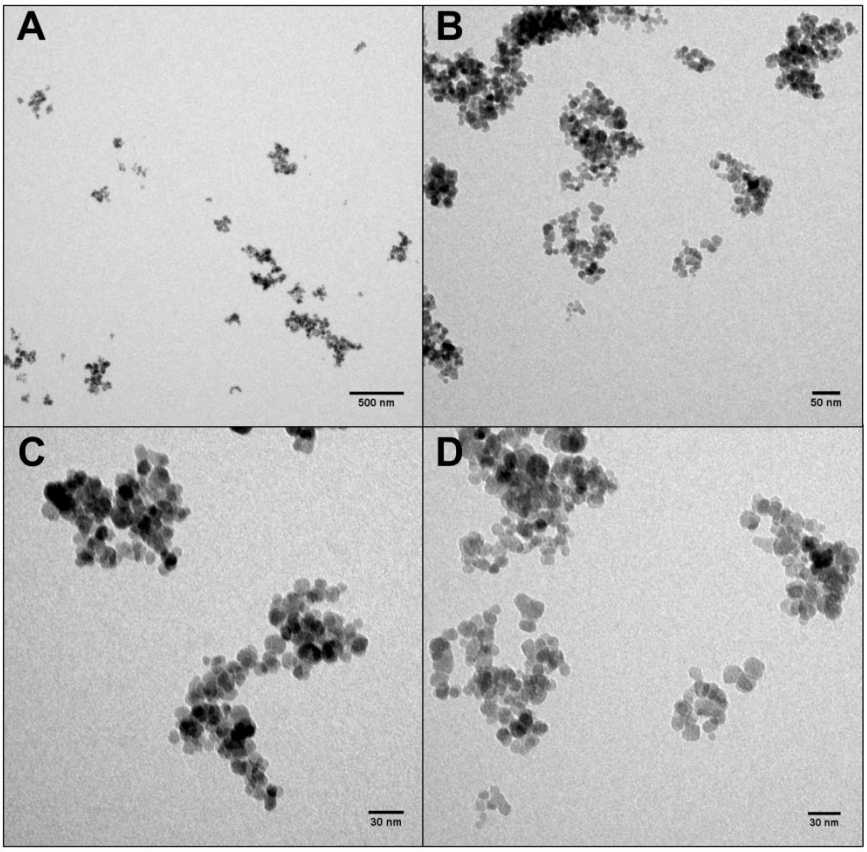


Figure S1: TEM micrographs of pristine MCNP (A-D, different magnifications).

The control sample was treated exactly like MPTS@MCNP. The polymerization of P*t*BA was in both cases successful but according to TGA results no polymer was anchored to the MCNP surface in case of the pristine MCNP.

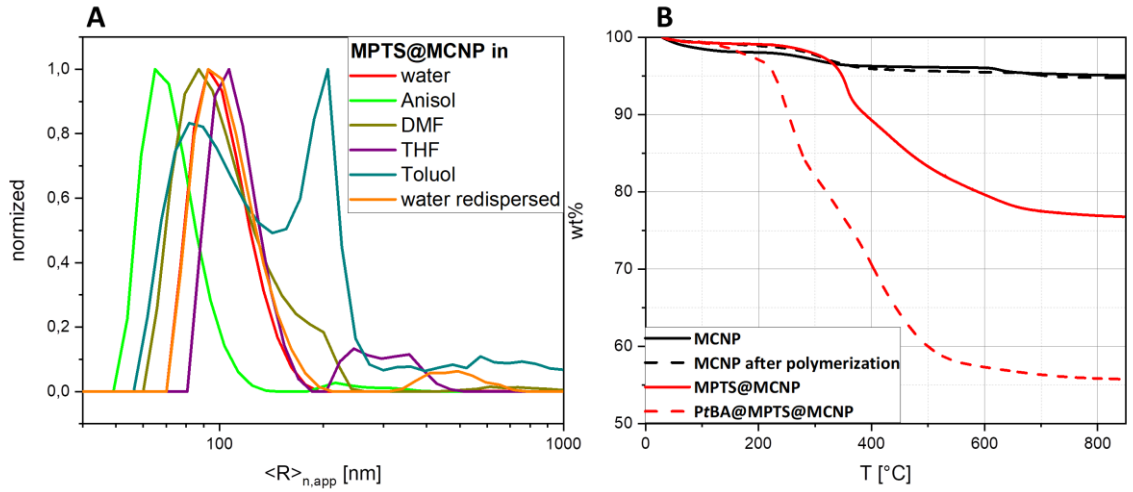


Figure S2: (A) Number-weighted DLS CONTIN plots of MPTS@MCNP obtained from a ratio MPTS:MCNP 4:1 in water (red line, $\langle R_h \rangle_{n,app}$ = 93 nm and diameter of 186 nm), MPTS@MCNP in anisol (green line, $\langle R_h \rangle_{n,app}$ = 65 nm and diameter of 130 nm), MPTS@MCNP in DMF (brown line, $\langle R_h \rangle_{n,app}$ = 87 nm and diameter of 174 nm), MPTS@MCNP in THF (purple line, $\langle R_h \rangle_{n,app}$ = 106 nm and diameter of 212 nm); MPTS@MCNP in toluol (turquoise line, $\langle R_h \rangle_{n,app}$ = 82 and 207 nm and diameter of 164 respectively 414 nm), MPTS@MCNP redispersed in water (orange line, $\langle R_h \rangle_{n,app}$ = 93 nm and diameter of 186 nm) (B) Thermograms between 50°C and 850°C under synthetic air of MCNP (black line, 5 % overall weight loss), MCNP after polymerization attempt with *t*BA as monomer(black dashed line, 5.3% overall weight loss), MPTS@MCNP (red line, 23.2% overall weight loss), P*t*BA@MPTS@MCNP (red dashed line, 44.3% overall weight loss).

Equation S1: Formula used for the calculation of shell thickness according to TGA

$$r_s = \sqrt[3]{r_c^3 + \left(r_c^3 \left(\frac{\rho_c}{\rho_s}\right)\left(\frac{WL}{RM}\right)\right)} - r_c$$

r_s …shell thickness

r_c … core radius (from DLS: MPTS@MCNP $\langle R_h \rangle_{n,app}$ = 52 nm)

ρ_c … core density (approx. 3.88 g/cm³) →

$\rho(SiO_2)$[1] = 2.19 g/cm³

ρ(Magnetite(5.1 g/cm³) /Maghemite(5.24 g/cm³))[2] = 5.17 g/cm³

$\rho((SiO_2)_{0.4}/(\text{Magnetite/Maghemite})_{0.6})$ = 3.98g/cm³ [a]

ρ_s … density of shell material ρ(P*t*BA)[3] = 1 g/cm³

ρ(PMMA)[4] = 1.18 g/cm³

ρ(PS)[5] = 1.06 g/cm³

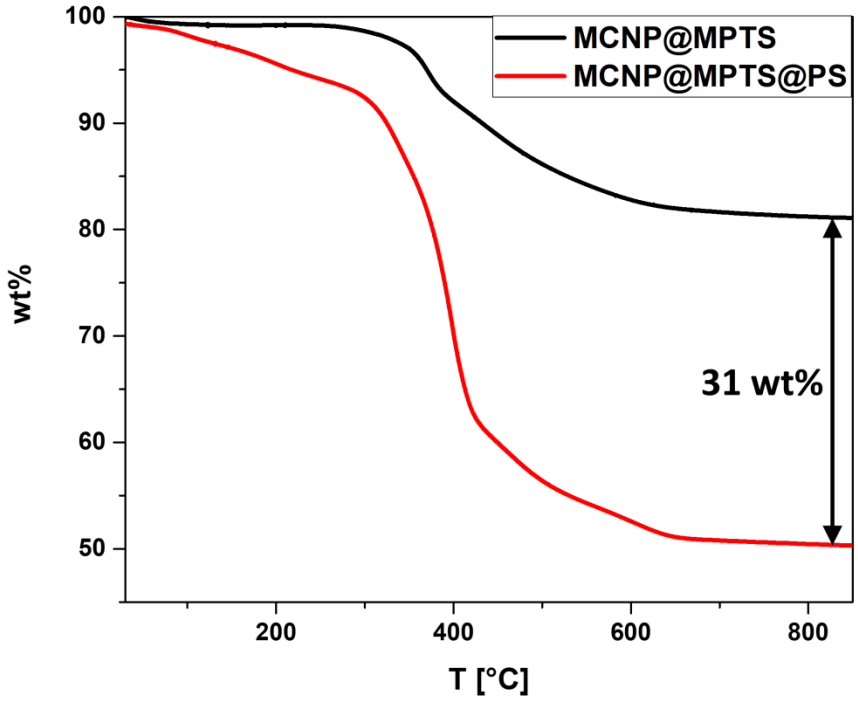
ρ(P2VP)[6] = 1.16 g/cm³

ρ(PNIPAM)[7] = 1.1 g/cm³

WL … weight loss

RM … residual mass

[a] The density of the core is based on the assumption that it contains 60% iron oxide, which consists to 50% of Magnetite and 50% Maghemite, and 40% condensed MPTS, which has a similar density as silica. The ratio for MPTS/iron oxide is based on the thermo gravimetric measurements showing a weight loss of 23.6% attributed to the MPTS shell. As The MPTS shell consists of 59% thermo degradable organic compounds and 41% non-degradable silica the 23.6% weight loss in TGA measurements lead to approximately 40% MPTS-shell in the particles.



FigureS3: Thermograms between 50°C and 850°C under synthetic air of MPTS@MCNP (black line, 19 % overall weight loss), PS@MPTS@MCNP (red line, 50% overall weight loss).

References

1. Harald, F.; Hartmann-Schreier, J. Siliciumdioxid. RÖMPP [Online], Stuttgart, Georg Thieme Verlag: 2016.
2. Redaktion; Sitzmann, H. Eisenoxide. RÖMPP [Online], Stuttgart, Georg Thieme Verlag: 2013.
3. Miller, M.L.; Rauhut, C.E. Crystalline Poly(tert-butyl acrylate). *J. Polym. Sci.* **1959**, *38*, 63-72, doi:10.1002/pol.1959.1203813307.
4. Kaiser, W. Kunststoffchemie für Ingenieure : von der Synthese bis zur Anwendung. *Carl Hanser, München* **2011**, 353f.
5. Wang, C.; Hsu, C.-H.; Lin, J.-H. Scaling Laws in Electrospinning of Polystyrene Solutions. *Macromolecules* **2006**, *39*, 7662-7672, doi:10.1021/ma060866a.
6. Urakawa, O.; Yasue, A. Glass Transition Behaviors of Poly (Vinyl Pyridine)/Poly (Vinyl Phenol) Revisited. *Polymers* **2019**, *11*, 1153.
7. Sbeih, S.; Mohanty, P.S.; Morrow, M.R.; Yethiraj, A. Structural Parameters of Soft PNIPAM Microgel Particles as a Function of Crosslink Density. *J. Colloid Interface Sci.* **2019**, *552*, 781-793, doi:https://doi.org/10.1016/j.jcis.2019.05.047.