Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information for the manuscript

The Pivotal Step of Nanoparticle Functionalization for the Preparation of Functional and Magnetic Hybrid Opal Films

D. Scheid[a], D. Stock[a], T. Winter[a], T. Gutmann[b,*], C. Dietz[c,d], and M. Gallei[a,*]

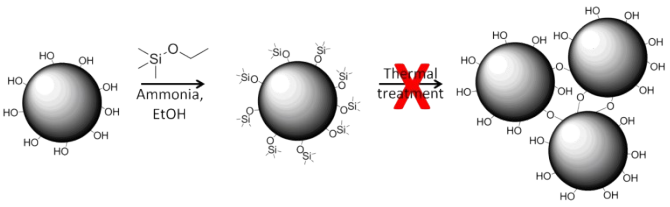

Fig. S1 Modification of silica surface with TMES avoiding inter-particle condensation reactions.

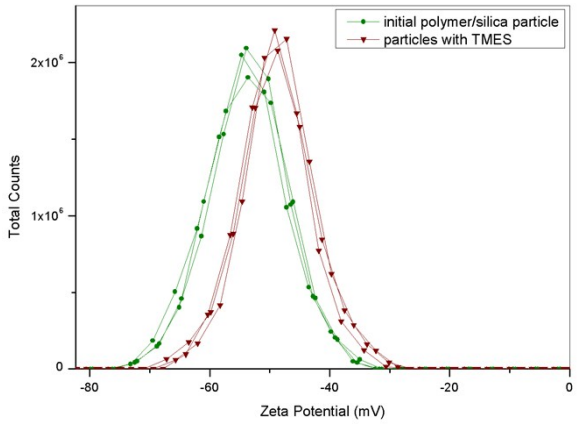

Fig. S2. Zeta potential of initial hybrid particles and TMES-modified particles.

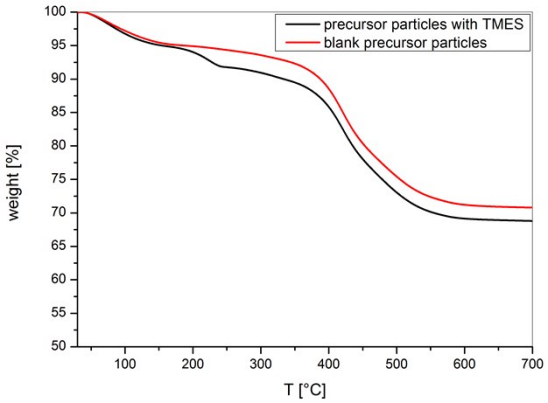

Fig. S3. TGA measurement of bare polymer/silica particles and particles modified with TMES.

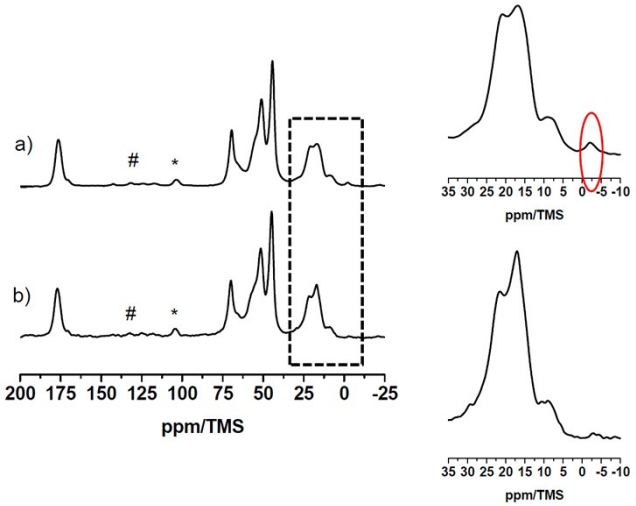

Fig. S4. ^{13}C CP MAS spectra measured at 11 kHz spinning with a contact time of 2 ms of a) sample TMES, and b) sample Stöber. Note: Signals marked with # and * are spinning sidebands.

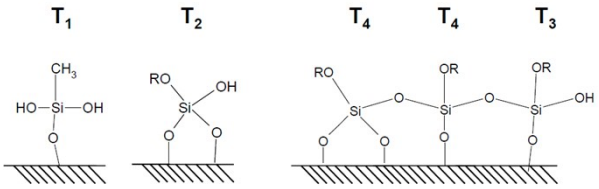

Fig. S5. Structural assignment of Tn groups (derived from Albert *et al.*).[25]

Table S1. T_1 relaxation times for ^{29}Si extracted by biexponential fit of the data from saturation recovery experiments.

Sample Name	T1 short	T1 long
Sample TMES	15.4 s	134.4 s
Sample Stöber	1.9 s	62.1 s
Sample Nanorattle 500°C	1.5 s	31.5 s

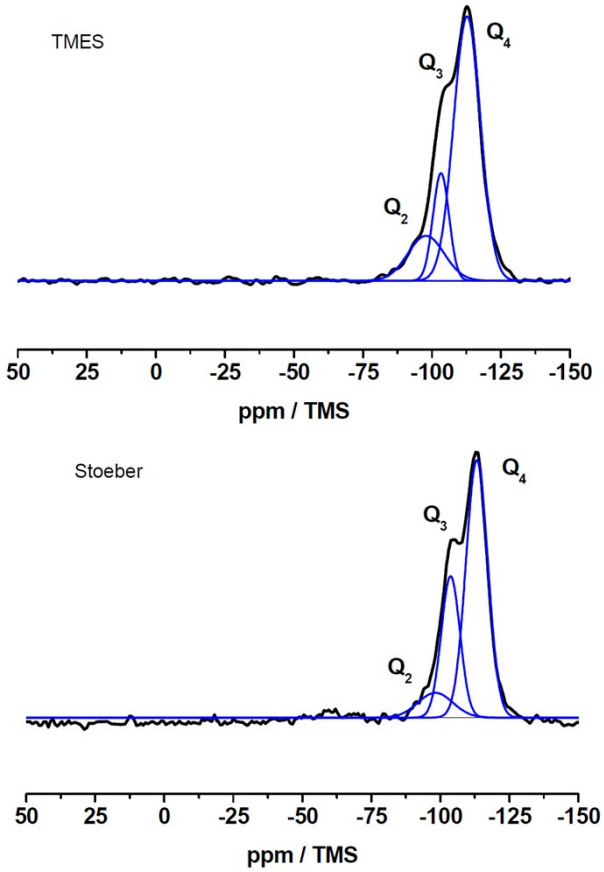

Fig. S6. ^{29}Si MAS spectra measured at 8 kHz spinning for quantification of Q_n groups for sample TMES measured with d1=412s and sample Stöber with d1=300s

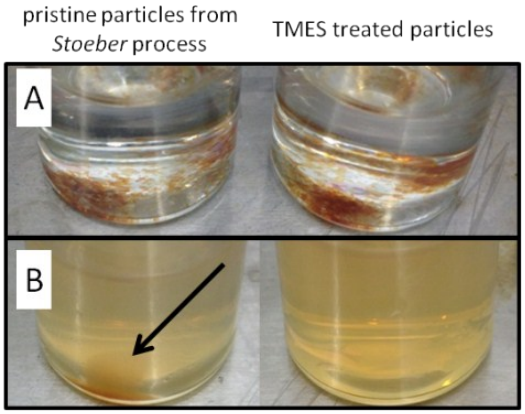

Fig. S7. Dispersions of the pristine particles obtained from the Stöber process (left) and particles treated with TMES (right) in water (after thermal treatment for 5h at 500 °C) are compared before (A) and after

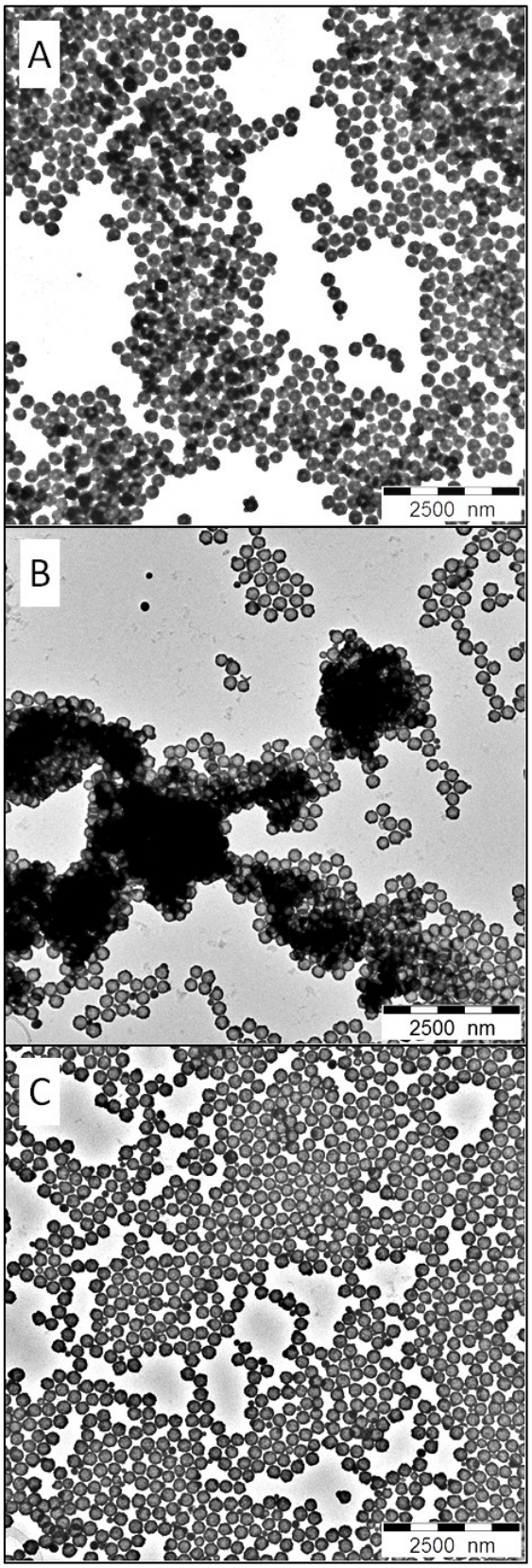

Fig. S8. TEM image of the particle dispersions in water on carbon-coated copper grids after drying using the drop-cast method for the initial polymer/silica particle sample (A), after thermal treatment 5h, 500°C (B) and TMES modified particles after thermal treatment (C).

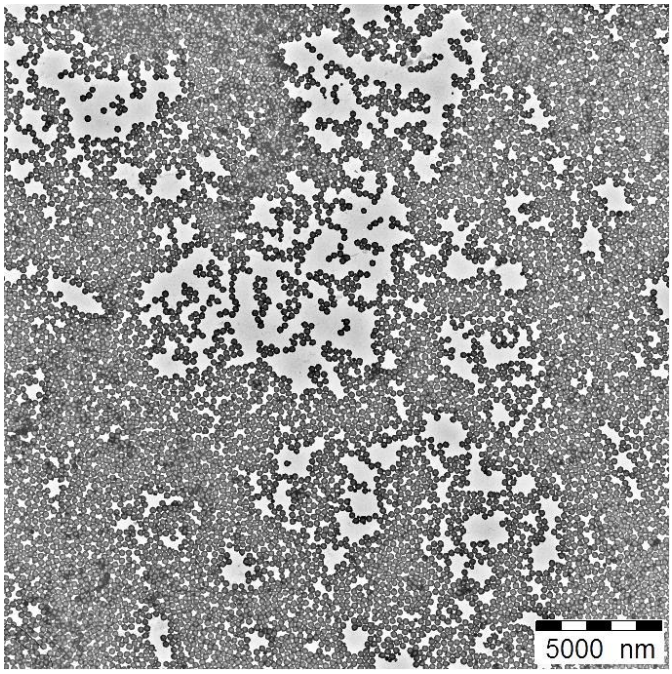

Fig. S9. TEM image of TMES-modified silica particles after thermal treatment and dispersing in water on carbon-coated copper grid after drying using the drop-cast method.

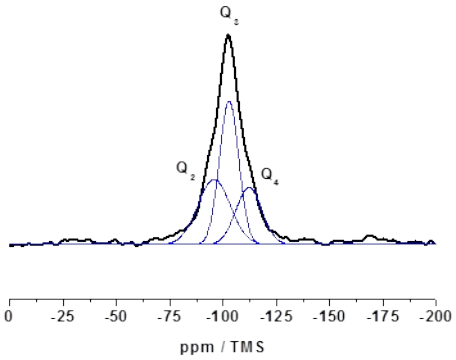

Fig. S10. ^{29}Si CP-MAS spectra of nanorattles after heat treatment at 500 °C.

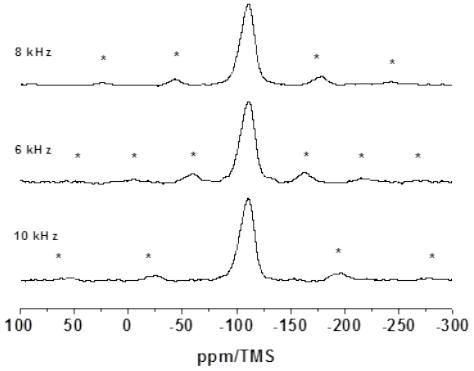

Fig. S11. ^{29}Si MAS spectra measured at different spinning rates employing a recycle delay of 2.5s and 5400 scans for the 8 kHz respectively 1536 scans for the 6 and the 10 kHz spectra.

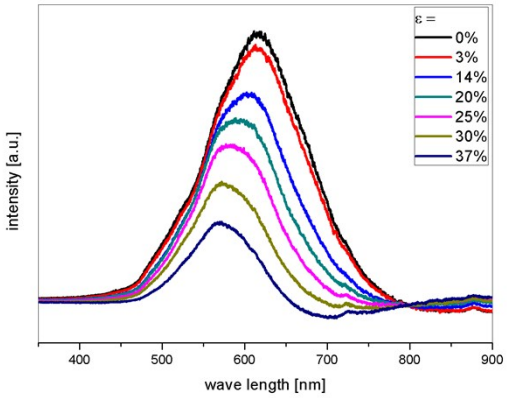

Fig. S12. Reflection spectra of elastomeric opal film dependent on strain ε.

Table S2. Calculation of reflected wave lengths λ_{111} and relative reflectivity R for various opal film materials and particle diameter.

material	particle diameter	reflected wave length	relative reflectivity
Opal film PE/SiO_2	**670 nm**	**1430 nm**	**0.005**
Opal filmPE/SiO_2	350 nm	745 nm	0.005
Opal film PEcoPBzMA/SiO_2	350 nm	755 nm	0.071
Inversopal SiO_2/air	350 nm	628 nm	0.998

The reflected wave length λ_{111} was calculated according to the following equation[1]:

$$\lambda_{111} = 2d\sqrt{\frac{3}{2}}n_{eff}sin\delta$$

The relative reflectivity R is calculated according to the following equation[2]:

$$R = \left[\frac{(n_0 - n_s\left(\frac{n_1}{n_2}\right)^{2N})^2}{(n_0 + n_s\left(\frac{n_1}{n_2}\right)^{2N})}\right]$$

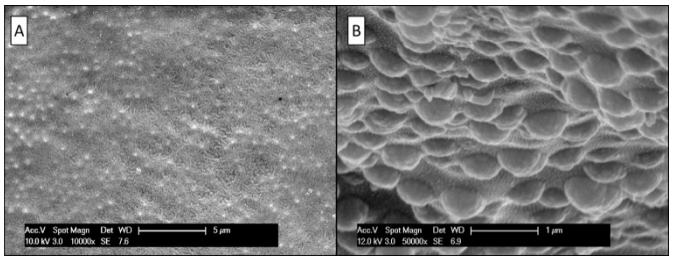

Fig. S13. SEM image of polymer film surface (A) and cross section (B) of elastomeric polymer film containing yolk/shell particles.

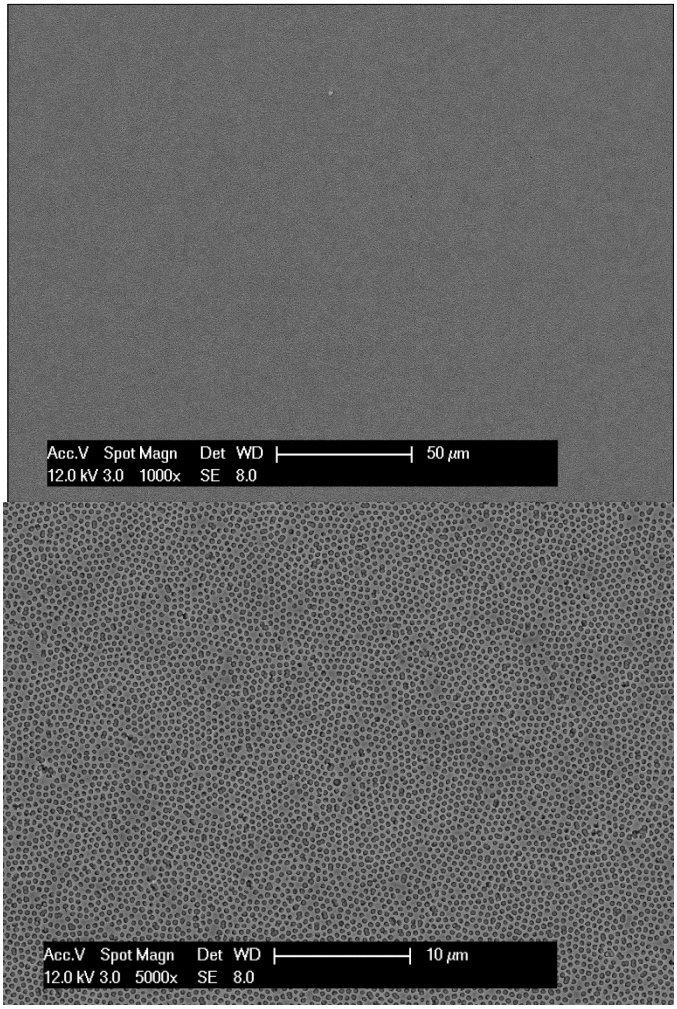

Fig. S14. SEM topography image of double inverse opal film.

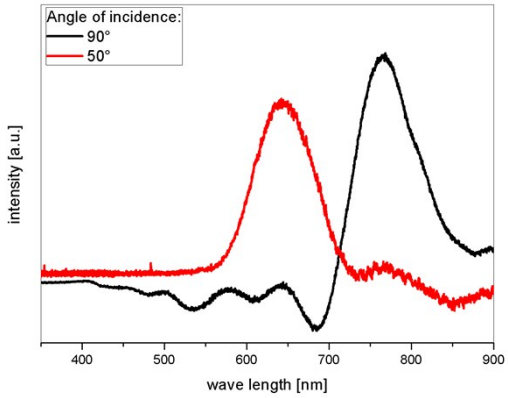

Fig. S15. UV/Vis reflection spectra of double-inverse opal film prepared by vertical deposition at 90° and 50° angle of incidence.

References

1. L. Gonzalez-Urbina, K. Baert, B. Kolaric, J. Perez-Moreno and K. Clays, *Chemical reviews*, 2012, **112**, 2268-2285.
2. J. Ge and Y. Yin, *Angew. Chem. Int. Ed. Engl.*, 2011, **50**, 1492-1522.