Supporting Information Section

Facile Surface Tailoring of Metal Oxide Nanoparticles via a Two-step Modification Approach

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I. Two-step modification of SiO_2 nanoparticles: The Silica nanoparticles were made by a Stöber process, where tetraethyl orthosilicate (TEOS) was used as a precursor, ammonium hydroxide and distilled water as catalyst and ethanol as solvent. In this manner, amorphous silica NPs with a particle size of 160 nm were synthesized. The particles were washed with ethanol and subsequently modified analogously to the alumina and zirconia nanoparticles as described in the Experimental Section.

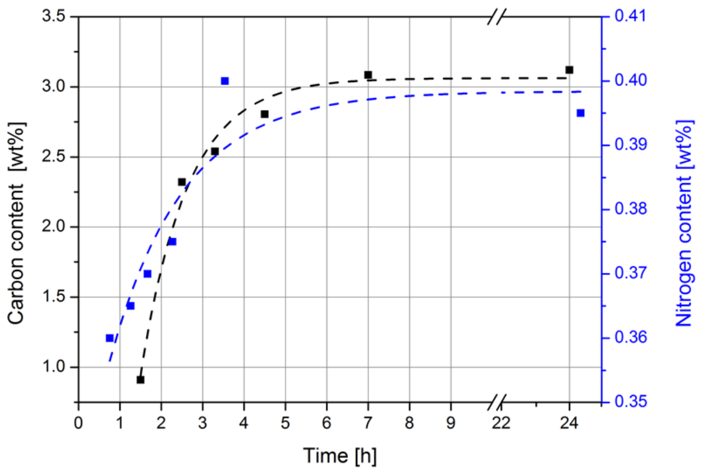

Figure S1: Carbon (black) and nitrogen (blue) contents of APTES-modified silica nanoparticles (NPs) at different times of reaction with APTES (APTES/SiO_2 wt ratio 1:5)

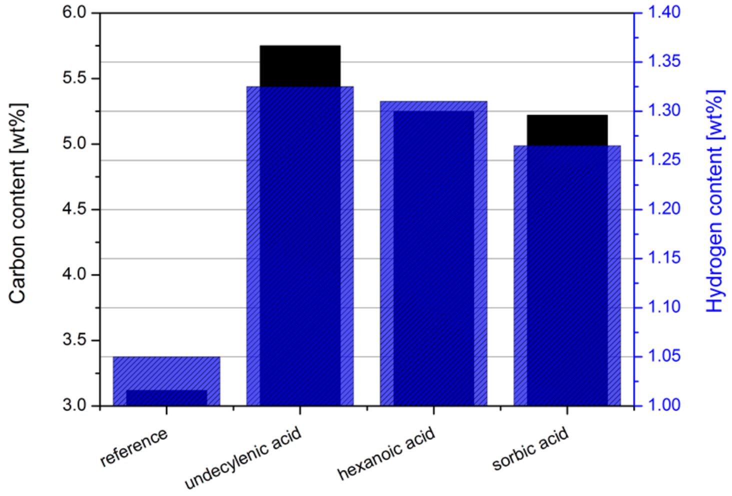

Figure S2: Carbon (black, solid) and hydrogen (blue, dotted) contents at the surface of silica NPs after two-step modification with different carboxylic acids

II. Electron microscopy analysis of the utilized nanoparticles:

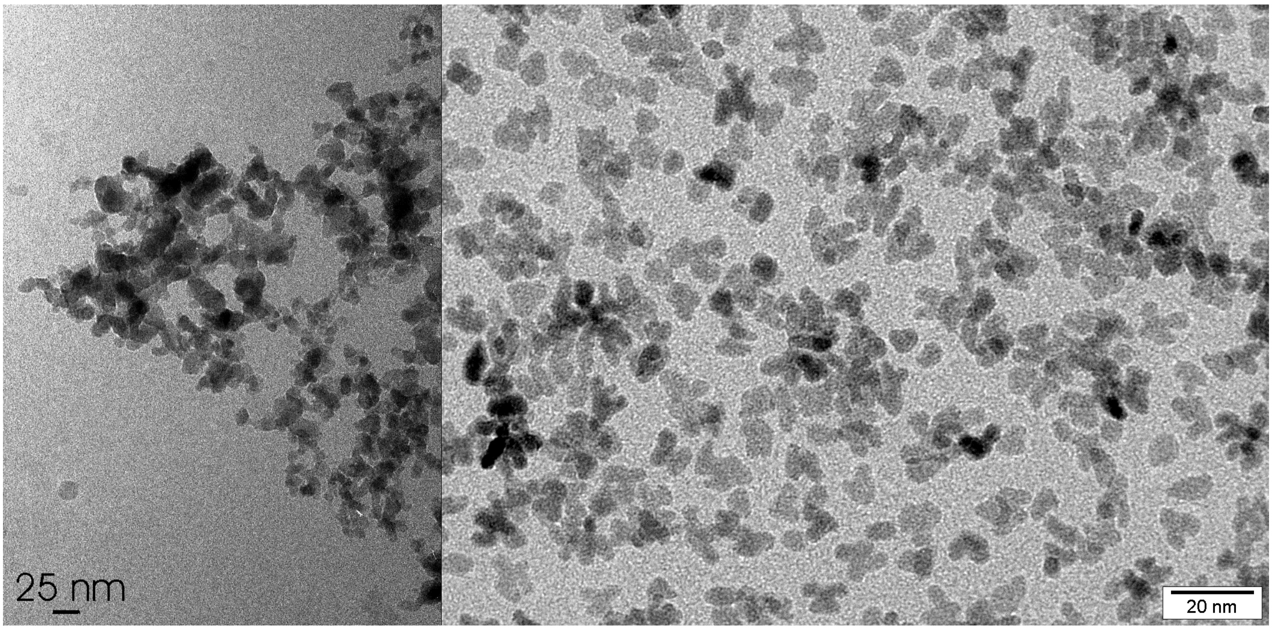

Figure S3: Transmission electron microscope images of alumina (left) and zirconia (right) NPs modified with APTES.

III. Effect of the second modification step on particle size distribution (example of undecylenic acid as a hydrophobic carboxylic acid in ethanol)

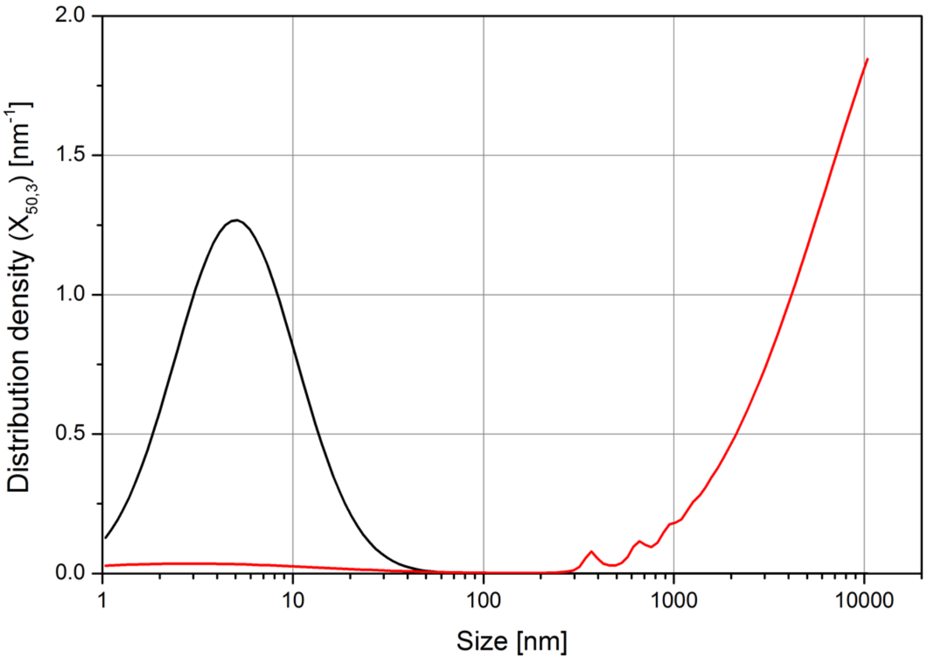

Figure S4: Distribution density of modified zirconia NPs in ethanol modified with APTES (black) and APTES-undecylenic acid (red)

IV. Fourier transform (FT) infrared spectroscopy of selected samples after the second modification step (each spectrum is compared to the corresponding free carboxylic acid as reference)

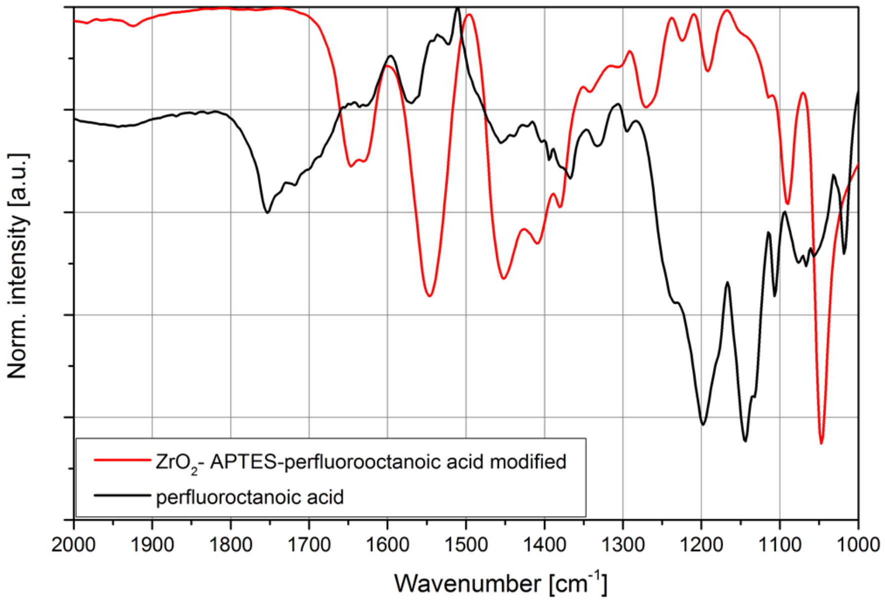

Figure S5: FT-IR spectrum (fingerprint region) of APTES-perfluorooctanoic acid-modified zirconia NPs

Some typical IR absorptions for perfluorooctanoic acid are still visible, but slightly shifted to lower energies after the coupling to the APTES-NPs, and a new double peak at 1560 and 1630 cm^{-1} for the peptide bond is established.

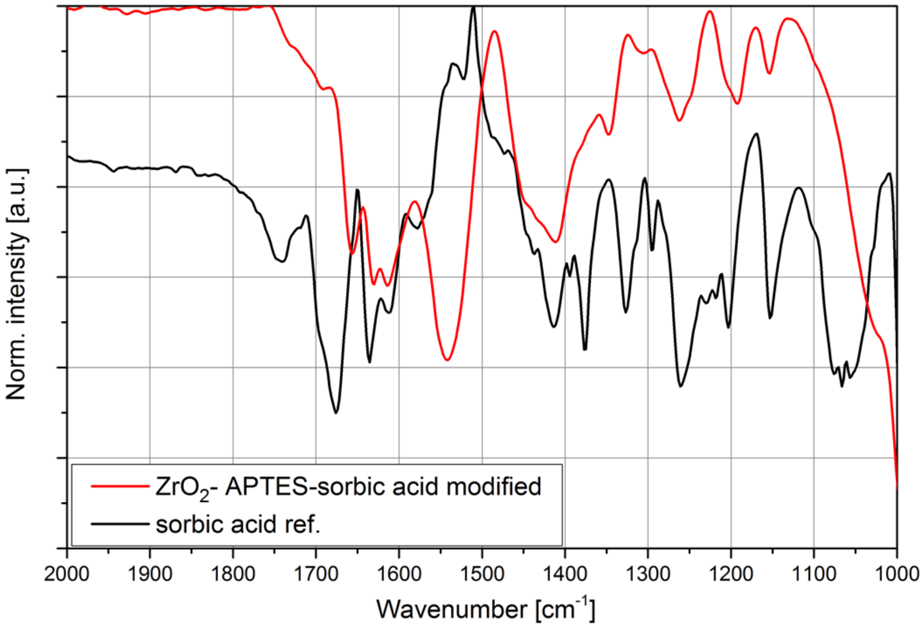

Figure S6: FT-IR spectrum (fingerprint region) of APTES-sorbic acid-modified zirconia NPs

Some typical IR absorptions for sorbic acid are still visible, but slightly shifted to lower energies after coupling to the APTES-NPs, and a new double peak at 1540 and 1600 cm^{-1} for the peptide bond is established.

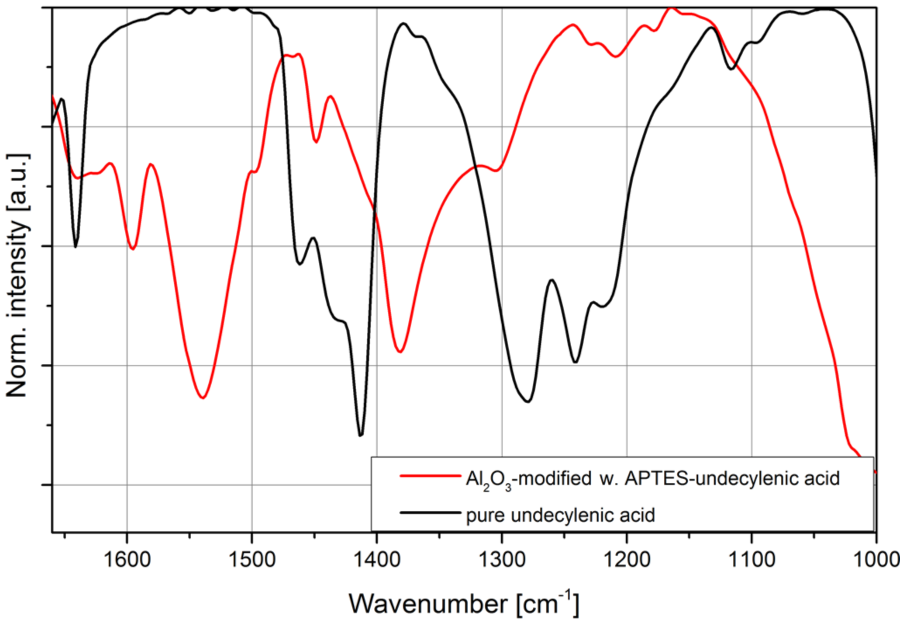

Figure S7: FT-IR spectrum (fingerprint region) of APTES-undecylenic acid modified alumina NPs

The typical IR absorptions for undecylenic acid are still visible, but slightly shifted to lower energies and a new double peak at 1540 and 1600 cm^{-1} for the peptide bond is established.