

Supplementary Information

Differential Effects of Surface-Functionalized Zirconium Oxide Nanoparticles on Alveolar Macrophages, Rat Lung, and a Mouse Allergy Model

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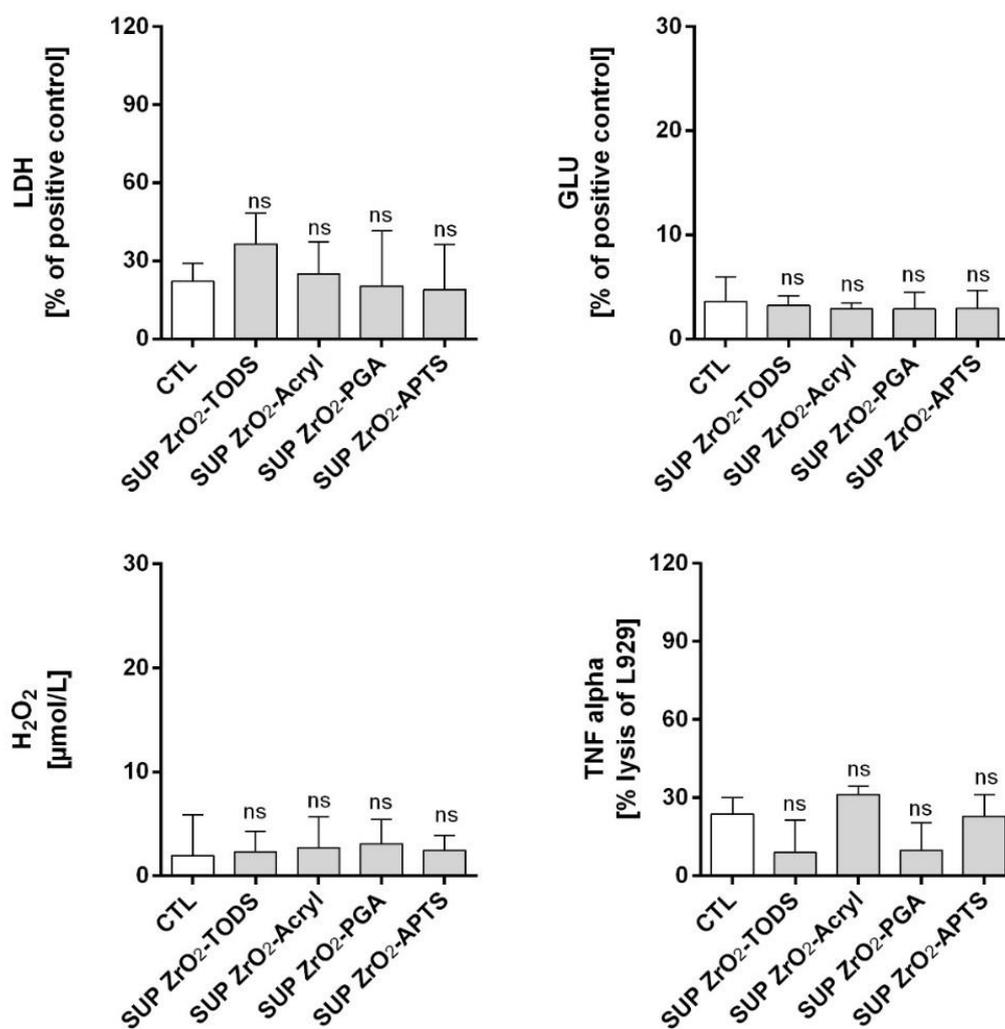


Figure S1. In vitro effects of supernatants generated from particle ZrO₂ NPs preparations. Particle stock suspensions of ZrO₂-TODS, ZrO₂-Acryl, ZrO₂-PGA, and ZrO₂-APTS were subjected to centrifugation (28,000 g, 8 h) to obtain particle-free supernatants (SUP). Volumes equivalent to the 180 μg/mL concentration (c.f. Figure 4) were then diluted in F-12K medium or KRPG buffer and applied to NR8383 macrophages. (ns) not significant, (CTL) untreated control cells.

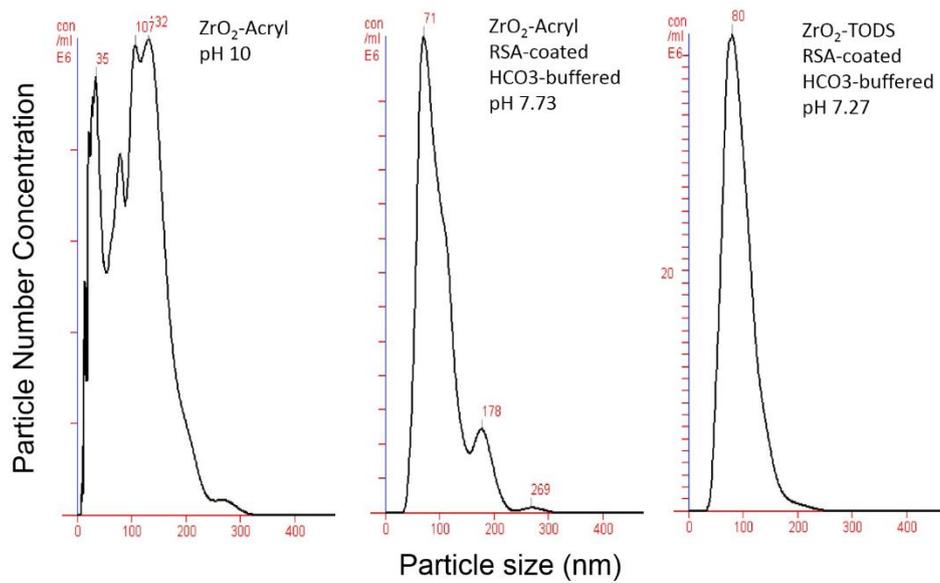


Figure S2. Size distribution of rat serum albumin-coated ZrO₂ particles as prepared for intratracheal administration in rats. Particles were buffered with 25 mM HCO₃⁻ and 5% CO₂. Measurements were carried out with optical particle tracking and NanoSight Software NTA 2.2 (Minton Park Amesbury, Wiltshire SP4 7RT, UK).

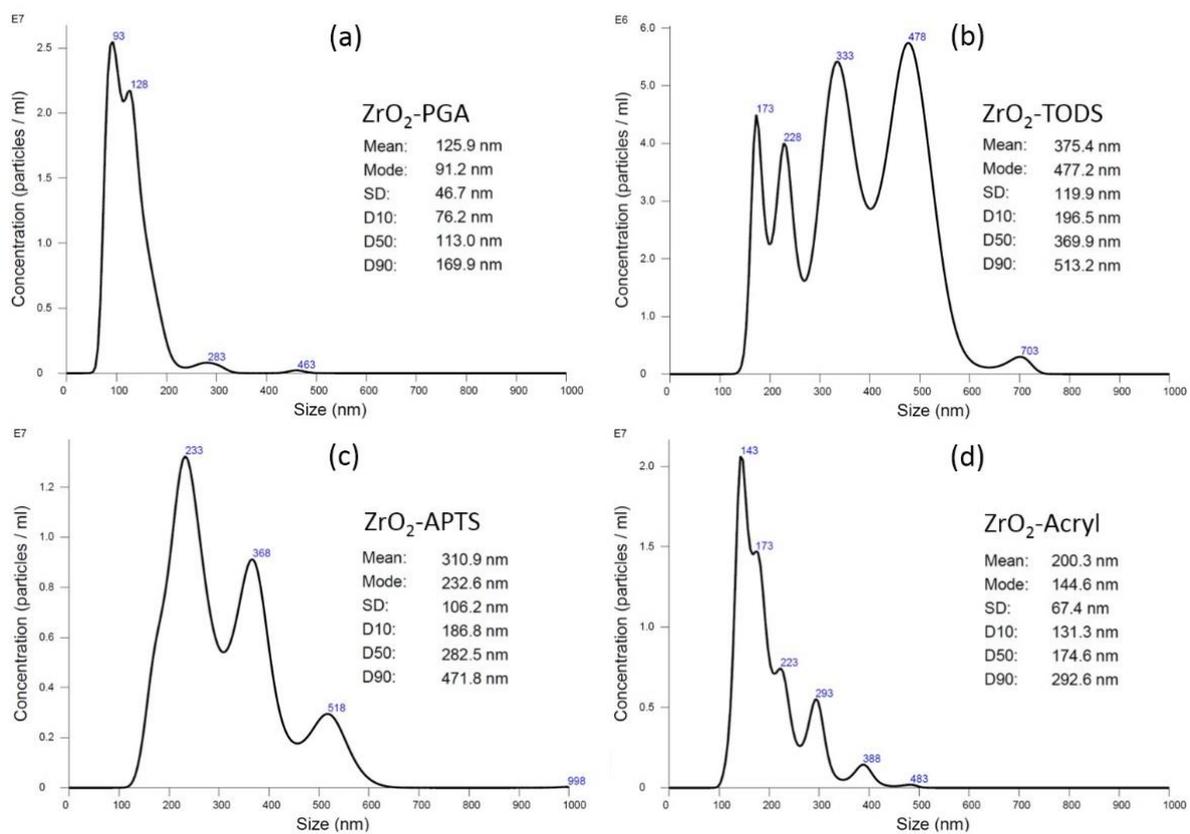
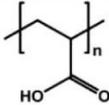
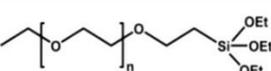
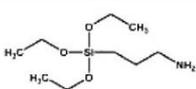
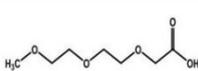


Figure S3. Size distribution of ZrO₂ nanoparticles dispersed in 0.9% NaCl/PBS as used for an administration study in ovalbumin-sensitized mice. (a) ZrO₂-PGA, (b) ZrO₂-TODS, (c) ZrO₂-APTS, and (d) ZrO₂-Acryl. Measurements were carried out with optical particle tracking and NanoSight Software NTA 3.1 (Minton Park Amesbury, Wiltshire SP4 7RT, UK).

Table S1. Characteristics of zirconia nanoparticles as published by the NanoGEM consortium. Data are taken from references [23,24] cited in the main text.

	ZrO ₂ -Acryl	ZrO ₂ -PGA	ZrO ₂ -APTS	ZrO ₂ -TODS
Organic residue	polyacrylic acid	polyethylene glycol (600 g/mol)	aminopropyltrimethoxy silane	trioxadecanoic acid
Particle size TEM [nm]	9	9	10	9
BET surface	117	117	105	117
Zeta potential (mV)	-29.2	-25.2	-20.5	-25.1
Structure				
Formula	-	HOOC-CH ₂ -(OC ₂ H ₄) _n -O-CH ₂ -COOH	H ₂ N-C ₃ H ₆ -Si(OCH ₃) ₃ SiC ₆ H ₁₅ O ₃ N	HOOC-CH ₂ -O-C ₂ H ₄ -O-C ₂ H ₂ -O-CH ₃ C ₇ O ₃ H ₁₄