Supporting Information

Ultraporous Superhydrophobic Gas-Permeable Nano-Layers by Scalable Solvent-Free One-Step Self-Assembly

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Table S1 Precursors and synthesis parameters of Mn_3O_4, TiO_2, SiO_2 and ZnO nano-layers.

Metal oxide	Solute	Solvent	Metal-atom concentration (mol L^{-1})	L_R (ml/min)	$O_{2-\Delta P}$ (L/min)	ΔP (bar)	HAB (cm)	Deposition time (min)
Mn_3O_4	Manganese(III) acetylacetonate	Acetonitrile & 2-ethylhexanoic acid (1:1 volumetric ratio)	0.2	4	5	2	17	3
TiO_2	Titanium isopropoxide & acetylacetone (1:4 mole ratio)	Acetonitrile & 2-ethylhexanoic acid (1:1 volumetric ratio)	0.2	4	5	2	17	3
SiO_2	Hexamethyldisiloxane & acetylacetone (1:3 mole ratio)	Acetonitrile & 2-ethylhexanoic acid (1:1 volumetric ratio)	0.2	4	5	2	17	3
ZnO	Zinc naphthenate	Xylene	0.3	4	3 / 5	2 / 3	20	3

L_R: precursor feed rate, $O_{2-\Delta P}$: dispersion O_2, ΔP: atomization pressure, HAB: height above burner.
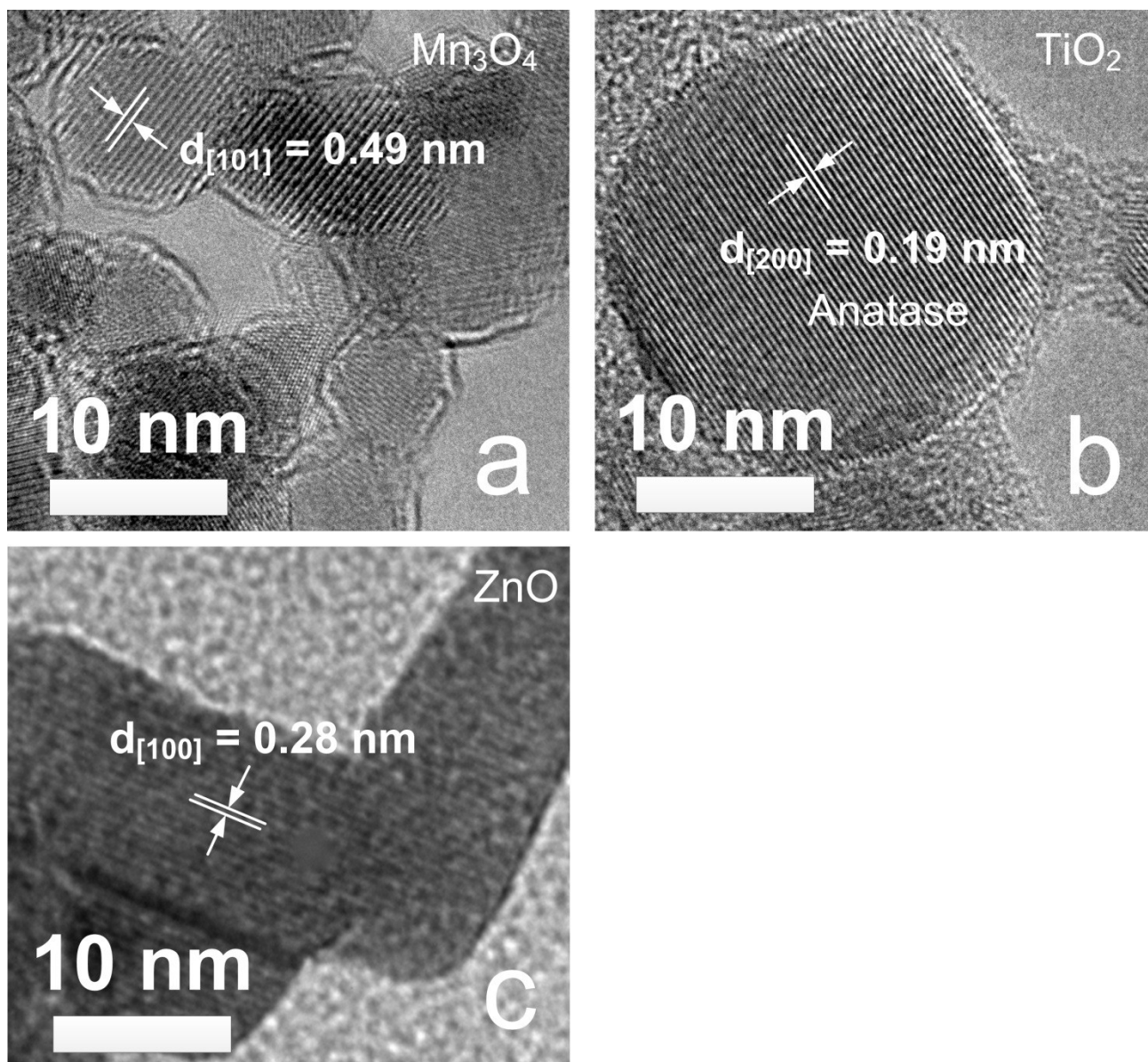
Figure S1. High-resolution TEM images of as-synthesized (a) Mn_3O_4, (b) TiO_2 and (c) ZnO nanoparticles.
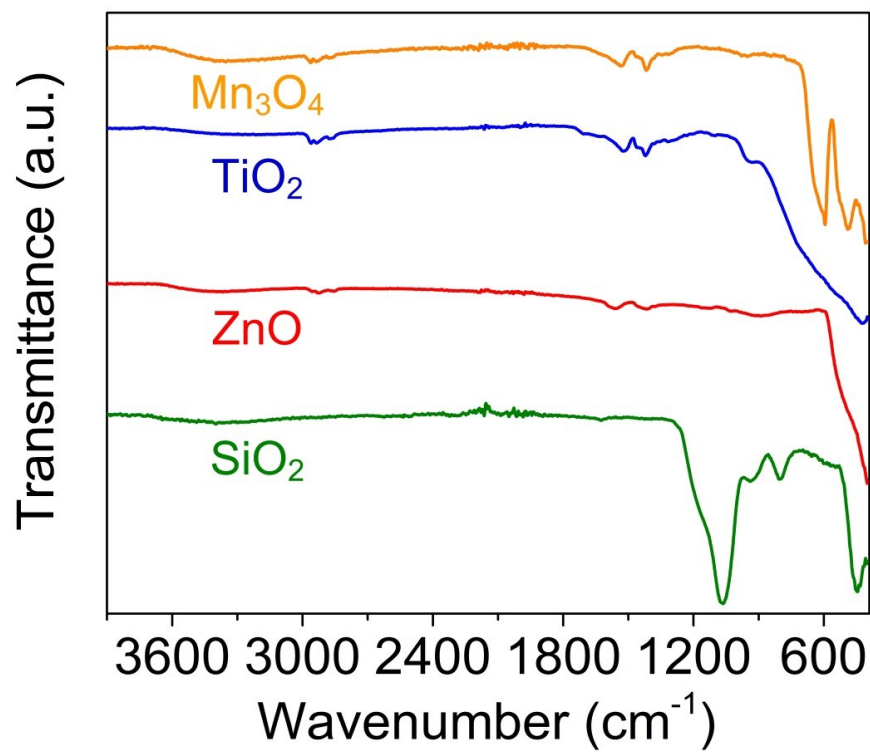
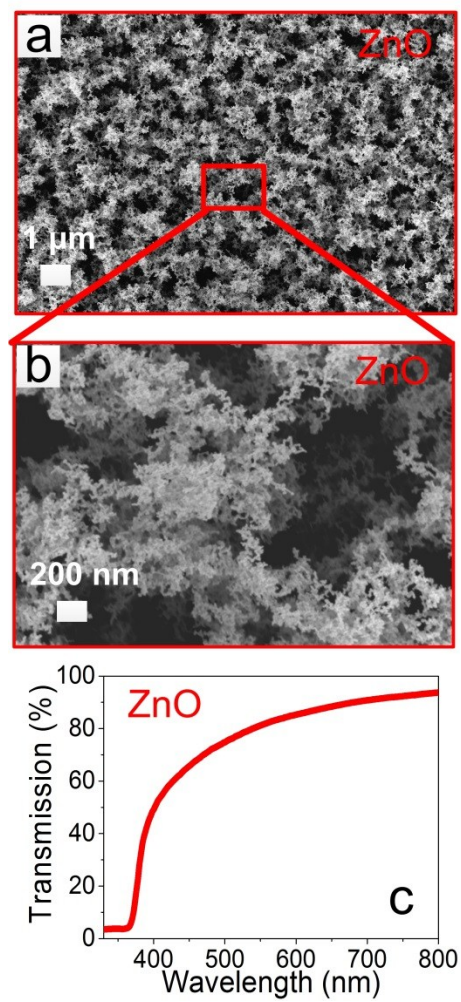**Figure S2.** FTIR spectra of the as-synthesized nanoparticles.

Figure S3. (a,b) SEM images and (c) UV-Vis transmission spectrum of ZnO nano-layers.
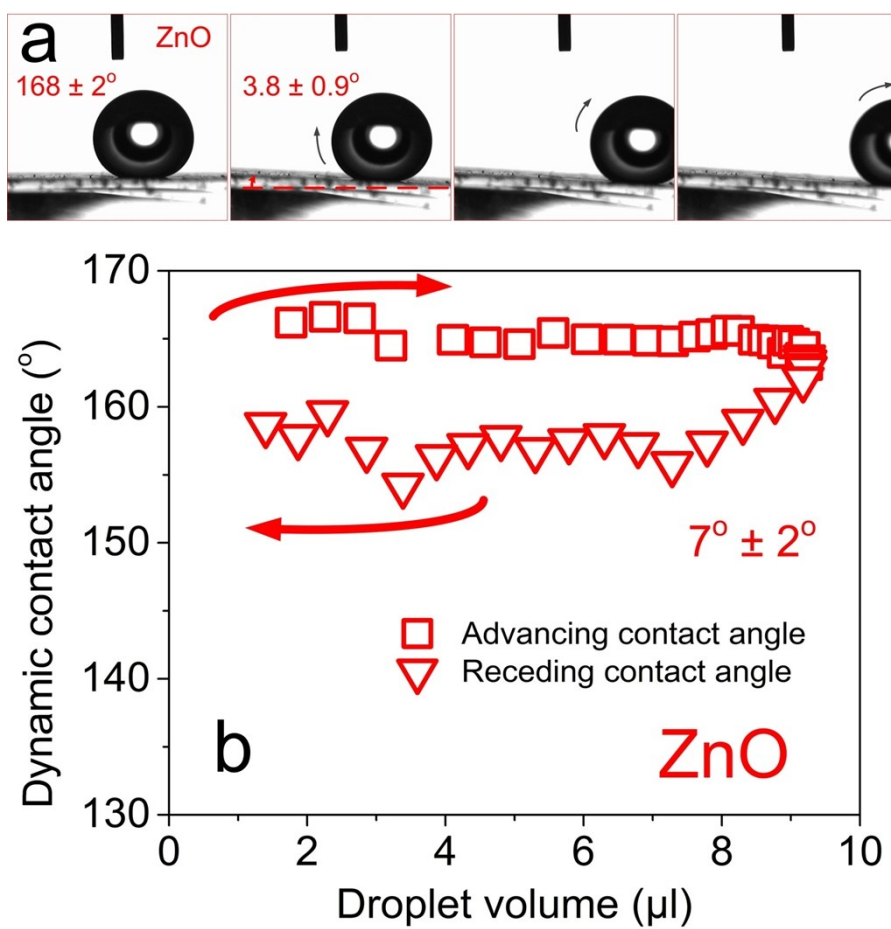
Figure S4. (a) Contact angle and sliding angle measurements and (b) Dynamic contact angle measurements of ZnO nano-layers (oxygen dispersion rate is 5 L min^{-1}).
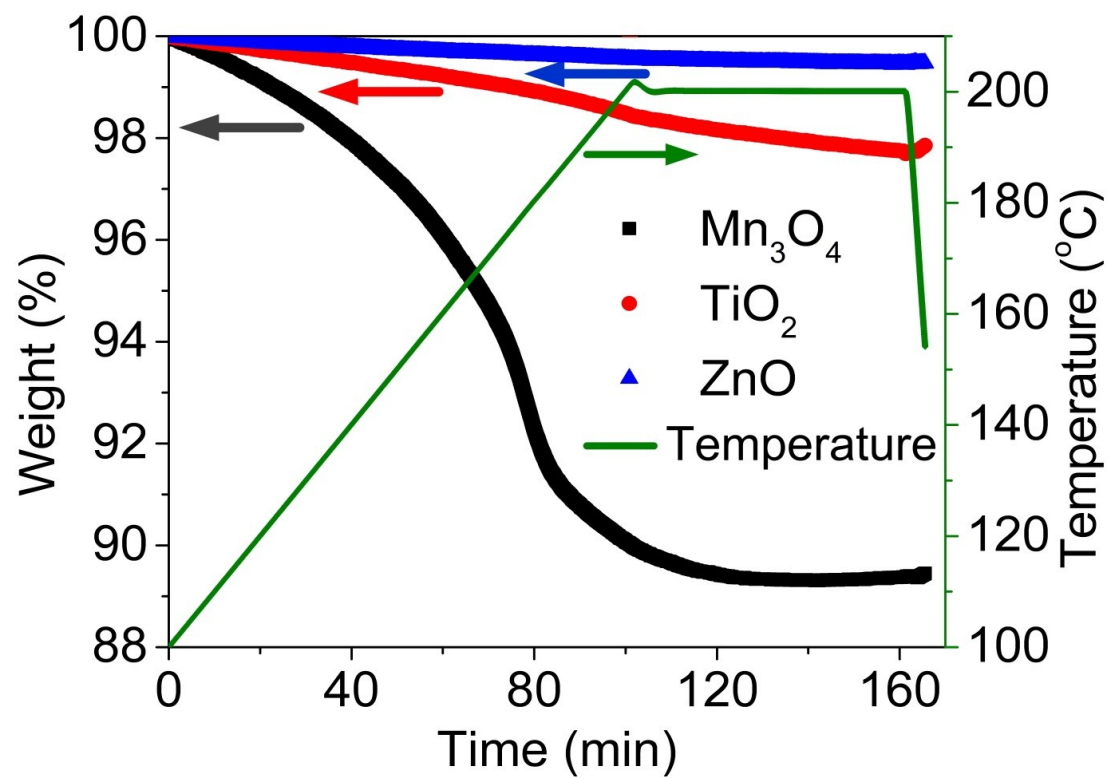
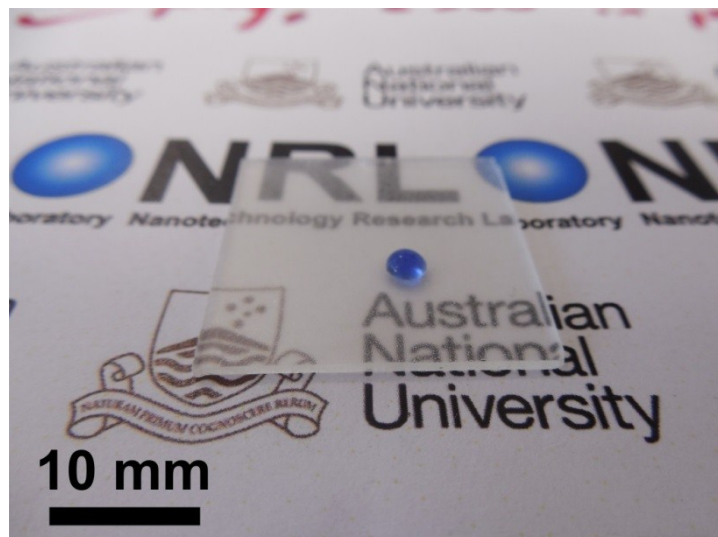**Figure S5.** TGA of as-synthesized Mn$_3$O$_4$, TiO$_2$ and ZnO nanoparticles.

Figure S6. A photograph of the water droplet on glass slide with polyurethane-acrylic based binder coating before superhydrophobic nanoparticle deposition.
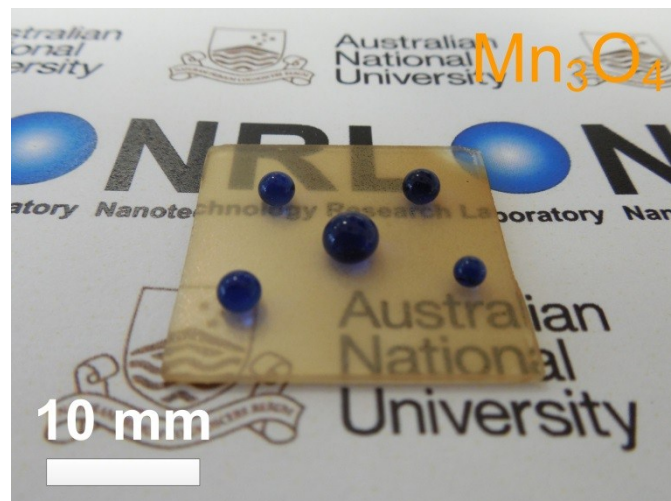
Figure S7. Photograph of the superhydrophobic Mn_3O_4 nano-layer on the glass slide.
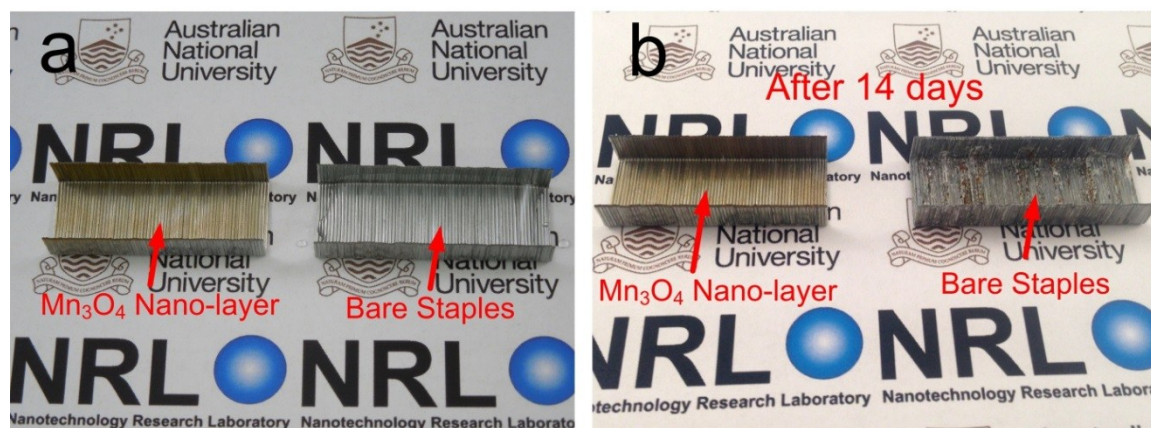
Figure S8. Anticorrosion properties of the ultraporous superhydrophobic Mn_3O_4 layers deposited on iron staples (a) before and (b) after repeated wetting with a salt solution (35 g L^{-1} NaCl in deionized water).
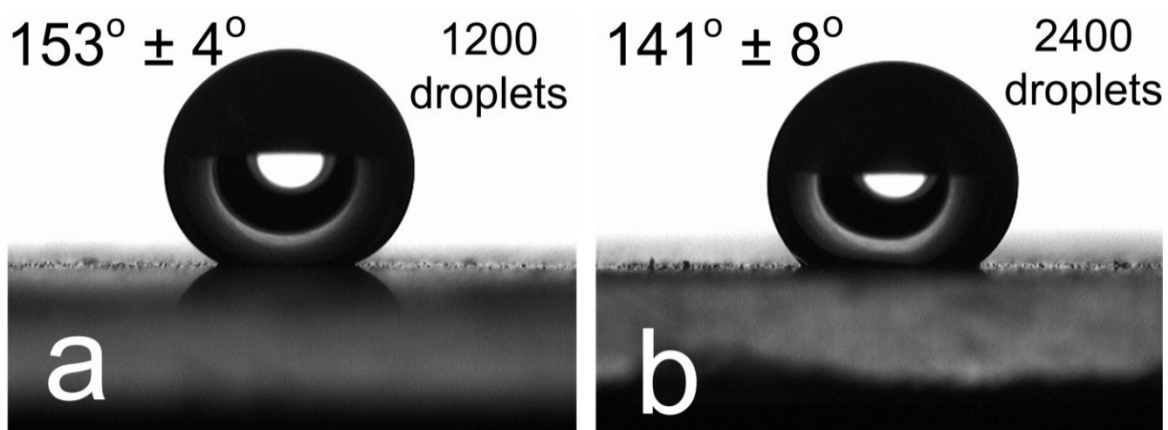
Figure S9. Contact angle measurements of TiO$_2$ nano-layers after stability test with (a) 1200 and (b) 2400 sequential droplets.
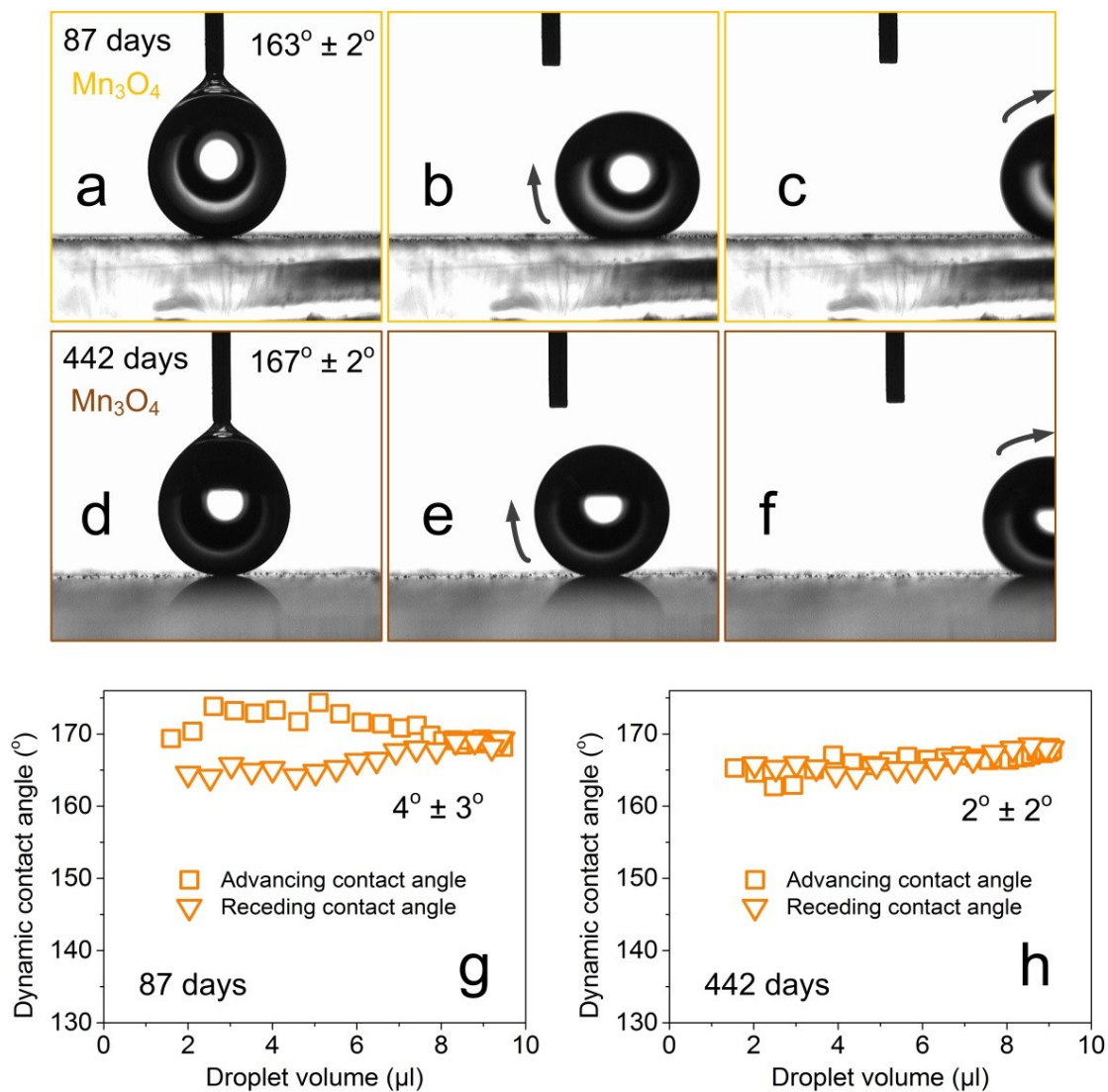
Figure S10. Contact angle characterization of Mn_3O_4 nano-layers stored in petri dishes for (a-c) 87 and (d-f) 442 days. Dynamic contact angle measurements of Mn_3O_4 nano-layers stored in petri dishes for (g) 87 and (h) 442 days.