

Supplementary Information

for

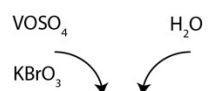
Transtympanic delivery of V2O5 nanowires with a tympanic- membrane penetrating peptide

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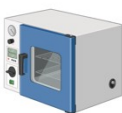
Step 1. Hydrothermal synthesis



Stir at room temperature



Transfer reactants into an autoclave



Heat in an oven at 180 °C

Step 2. Washing and drying



Wash with ethanol x3 times and water x3 times

Centrifuge to retrieve the nanowires after each wash



Lyophilize to remove solvents



Collect V_2O_5 nanowires

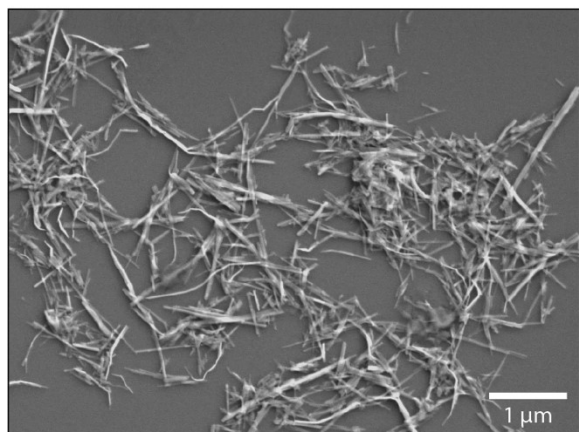
Supplementary figure 1. A scheme showing the overall process of synthesizing nanowires in house. Figure partially generated with Biorender.

Supplementary Table 1. A selection of nanowire batches made with various synthesis conditions.

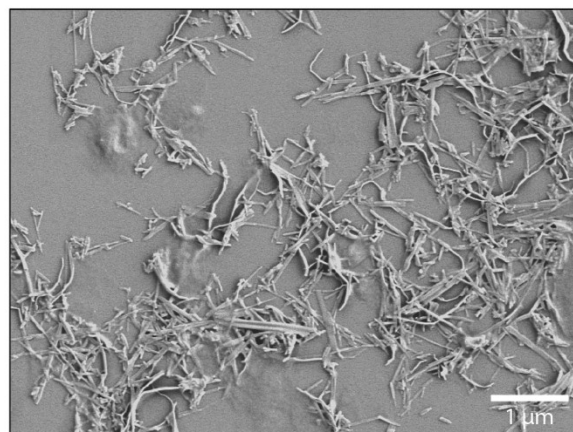
	Hydrothermal synthesis conditions					
Batch	Surfactant	pH	Temp (°C)	Time (hr)	Other	Length (mean ± SEM nm)
B3	none	<2	180	24		1012 ± 149
B5	none	<2	180	6		565 ± 89
B7	none	<2	180	12		579 ± 39
B9	0.5% PVA	<2	180	6		352 ± 36
B10	1% PEG-200	<2	180	6		1536 ± 193
B11	none	<2	180	6	22 mmol VOSO ₄	624 ± 44
B12	none	5.85	180	6		1781 ± 342
B13	none	<2	180	2		287 ± 25
B14	1% PEG-200	<2	180	2		238 ± 19
B15	0.1% SDS	<2	180	2		548 ± 101
B16	0.1% Triton	<2	180	2		361 ± 76

Abbreviations: PVA: polyvinyl alcohol, PEG: polyethylene glycol, SDS: sodium dodecyl sulphate, SEM: standard error mean

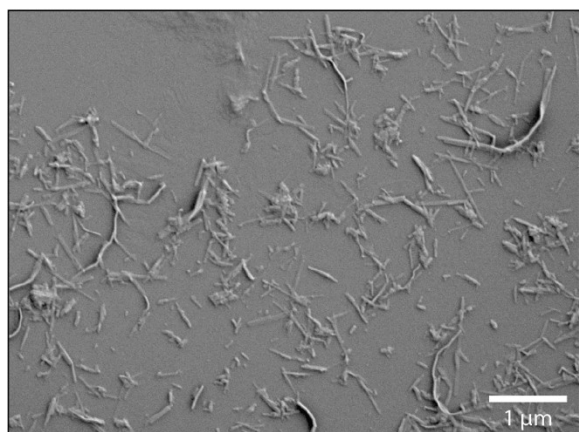
NW-24h



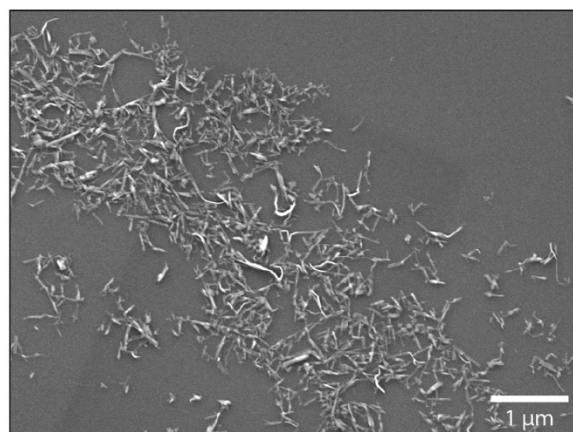
NW-12h



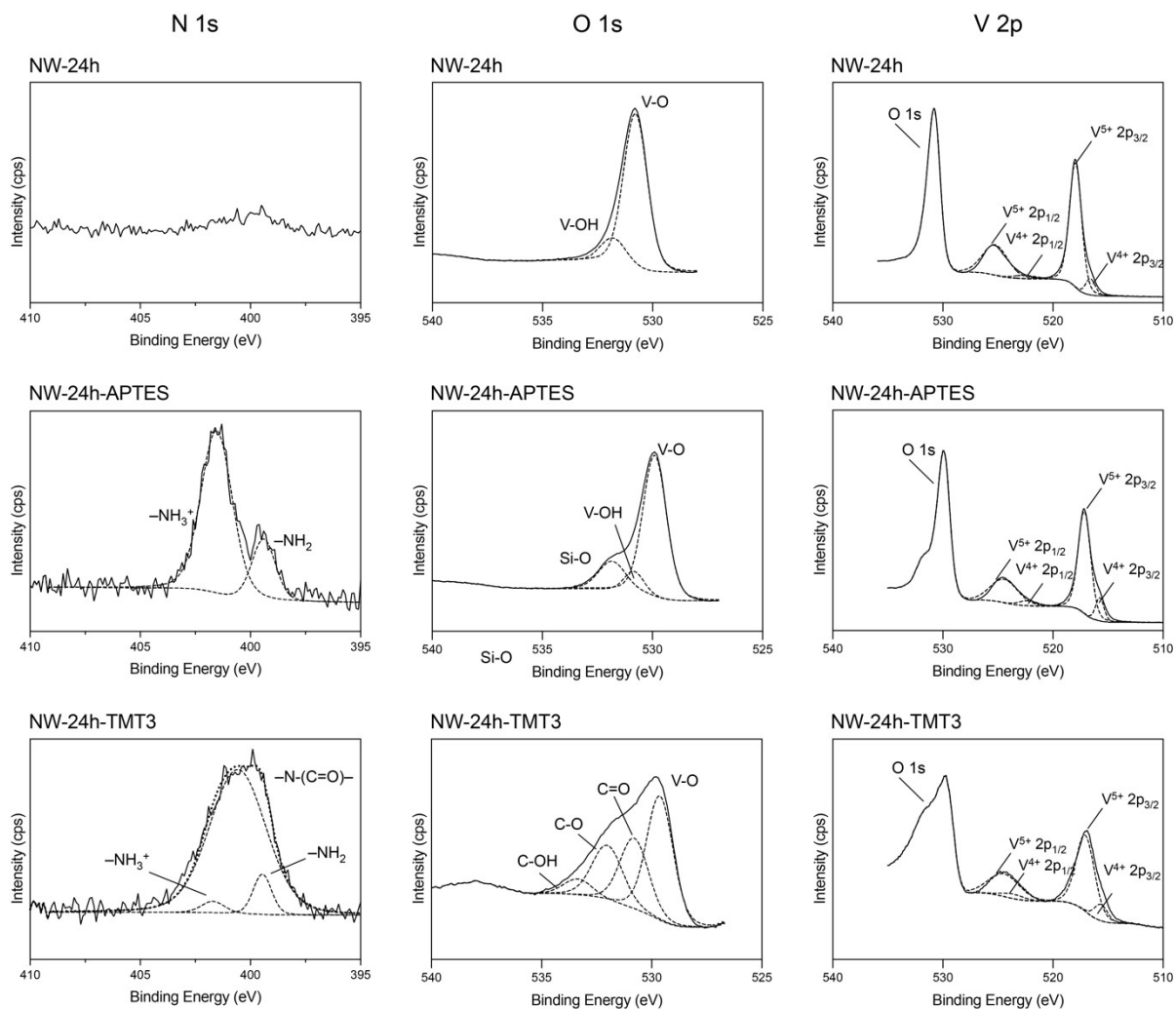
NW-6h



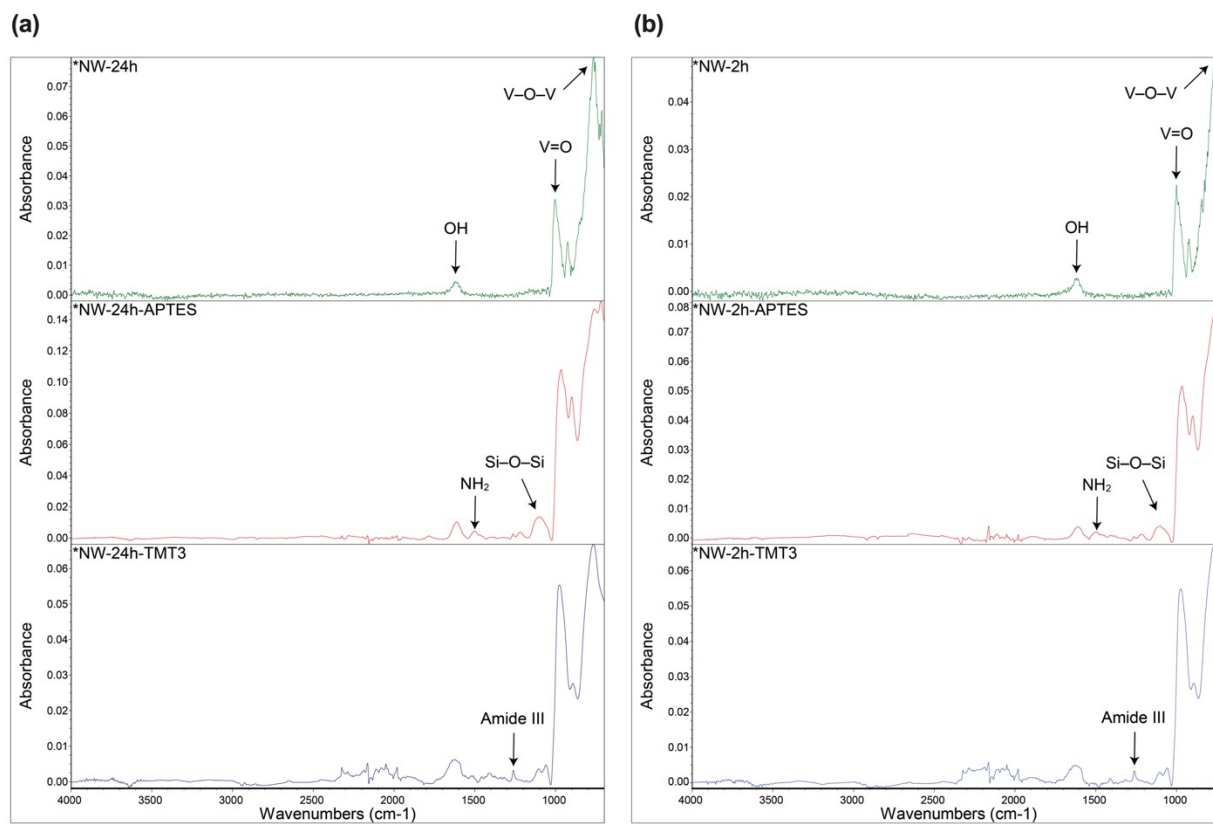
NW-2h



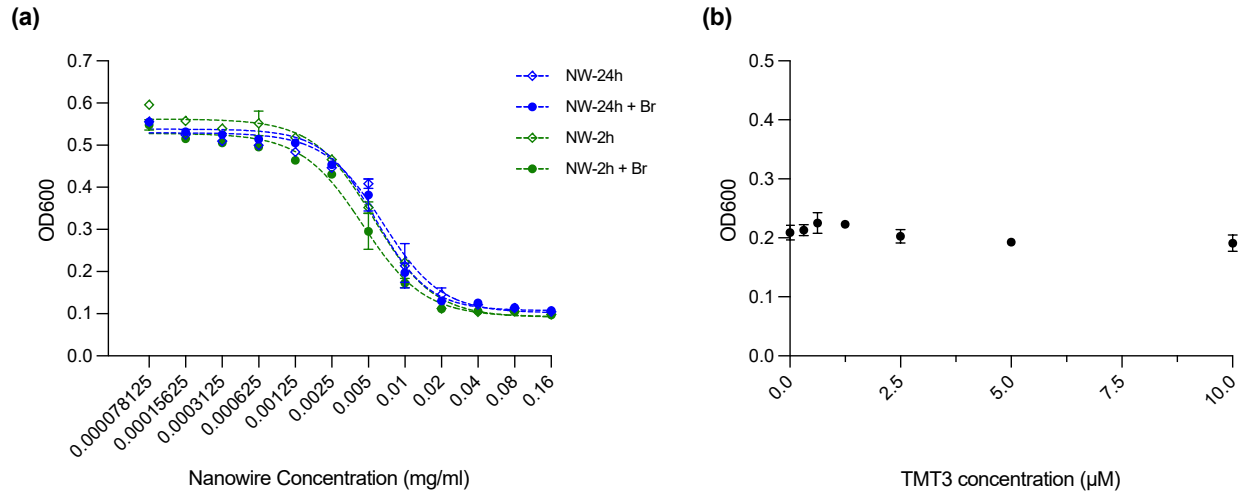
Supplementary figure 2. Representative scanning electron microscopy (SEM) images of nanowires produced from different synthesis conditions. High-resolution images showing the morphology of nanowires synthesized with 24-hour reaction (NW-24h), 12-hour reaction (NW-12h), 6-hour reaction (NW-6h), or 2-hour reaction (NW-2h).



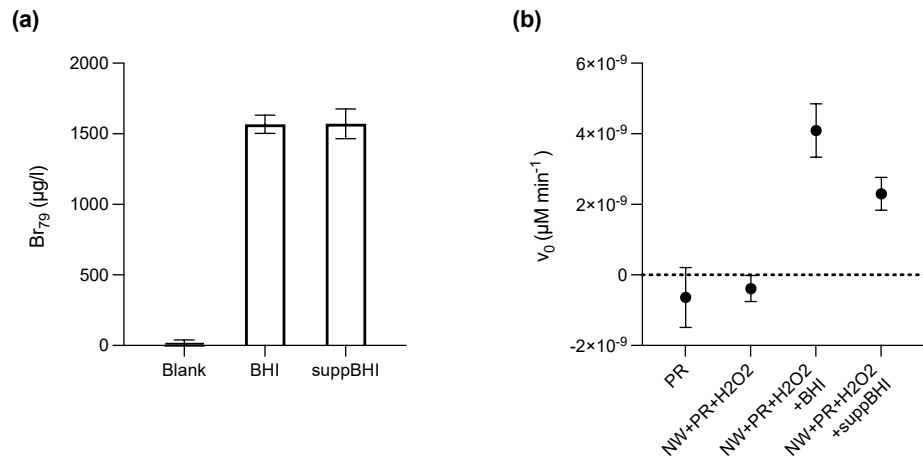
Supplementary figure 3. High resolution X-ray photoelectron spectroscopy (XPS) scans on N 1s, O 1s and V 2p for NW-24h, NW-24h-APTES, and NW-24h-TMT3.



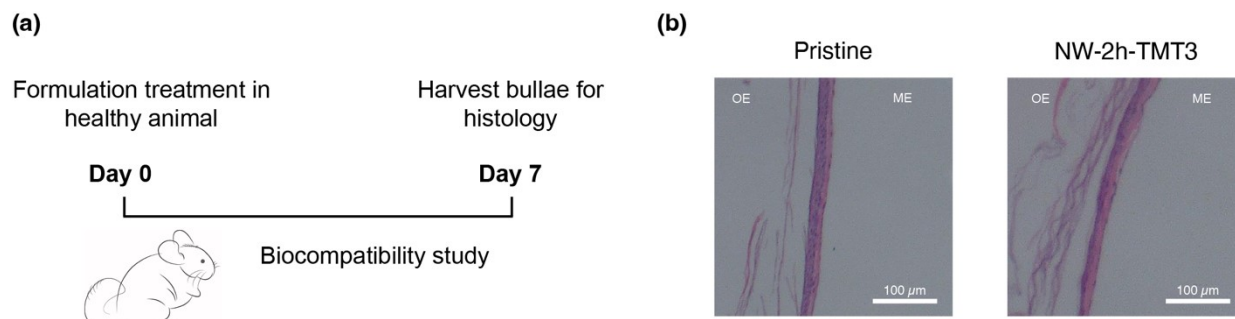
Supplementary figure 4. Fourier-transform infrared spectroscopy (FTIR) spectra for nanowires. a) FTIR spectra for NW-24h, NW-24h-APTES, and NW-24h-TMT3, **b)** FTIR spectra for NW-2h, NW-2h-APTES, and NW-2h-TMT3.



Supplementary figure 5. Concentration-dependent kill curve for nanowires against *S. pneumoniae*. **a)** The OD600 reading on *S. pneumoniae* culture treated with 0.000078125 – 0.16 mg/mL of NW-24h and NW-2h, with or without 1 mM KBr, and the fitted MIC50 curve shown in dashed lines. **b)** The OD600 reading on *S. pneumoniae* culture treated with 0 – 10 µM of TMT3 peptide; no antibiotic effect of TMT3 peptide was observed for concentrations up to 10 µM.

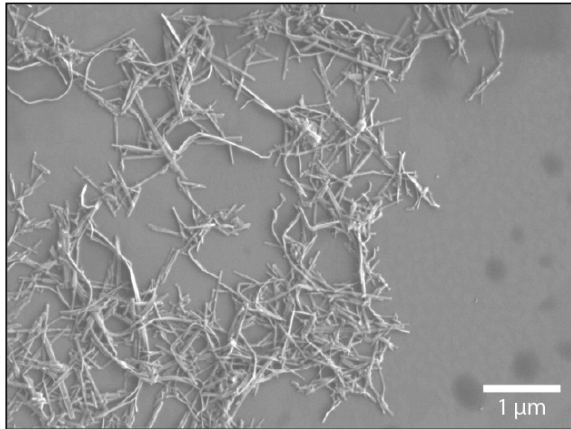


Supplementary figure 6. Bromide ion content in bacteria culture media. a) Inductively coupled plasma mass spectroscopy (ICP-MS) analysis showing the measured Br-79 content in blank sample, BHI media, and supplemented BHI (suppBHI). **b)** Catalytic activities measured using the phenol red (PR) bromination assay suggest the presence of bromide ions in bacteria culture media to support HOBr generation; formulations compositions are listed as follows, [PR]: 50 µM PR only, [NW + PR + H₂O₂]: 0.04 mg/mL NW-2h + 50 µM PR + 5 mM H₂O₂, [NW + PR + H₂O₂ + BHI]: 0.04 mg/mL NW-2h + 50 µM PR + 5 mM H₂O₂ + 26% BHI media, [NW + PR + H₂O₂ + suppBHI]: 0.04 mg/mL NW-2h + 50 µM PR + 5 mM H₂O₂ + 26% suppBHI media.

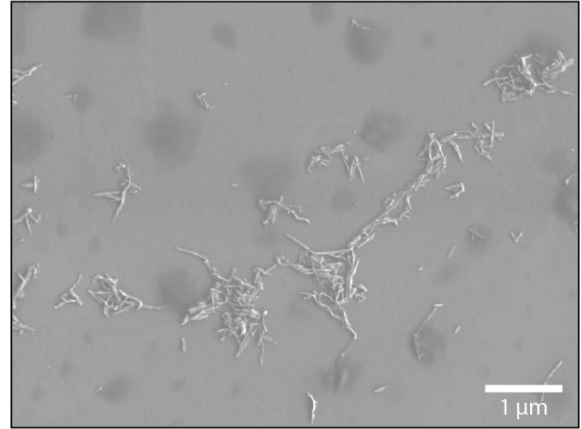


Supplementary figure 7. Biocompatibility study. **a)** A scheme showing the *in vivo* biocompatibility study timeline. **b)** A representative image showing the cross-sections of tympanic membranes that were untreated (pristine) or treated with 0.6 mg of NW-2h-TMT3 and 120 μ g of Br⁻ (NW-2h-TMT3) for 7 days in healthy chinchillas, OE = outer ear, ME = middle ear, scale bar = 100 μ m.

NW-24h



NW-2h



Supplementary figure 8. Nanowire stability after incubation in saline. SEM images showing the morphology of nanowires that were incubated in phosphate buffered saline (PBS) for 120 hours at 37 °C. Scale bar = 1 μm.