Electronic Supplementary Material (ESI) for Nanoscale Advances.

Supplementary Information

Soft landing of polyatomic anions onto three-dimensional semiconductive and conductive substrates

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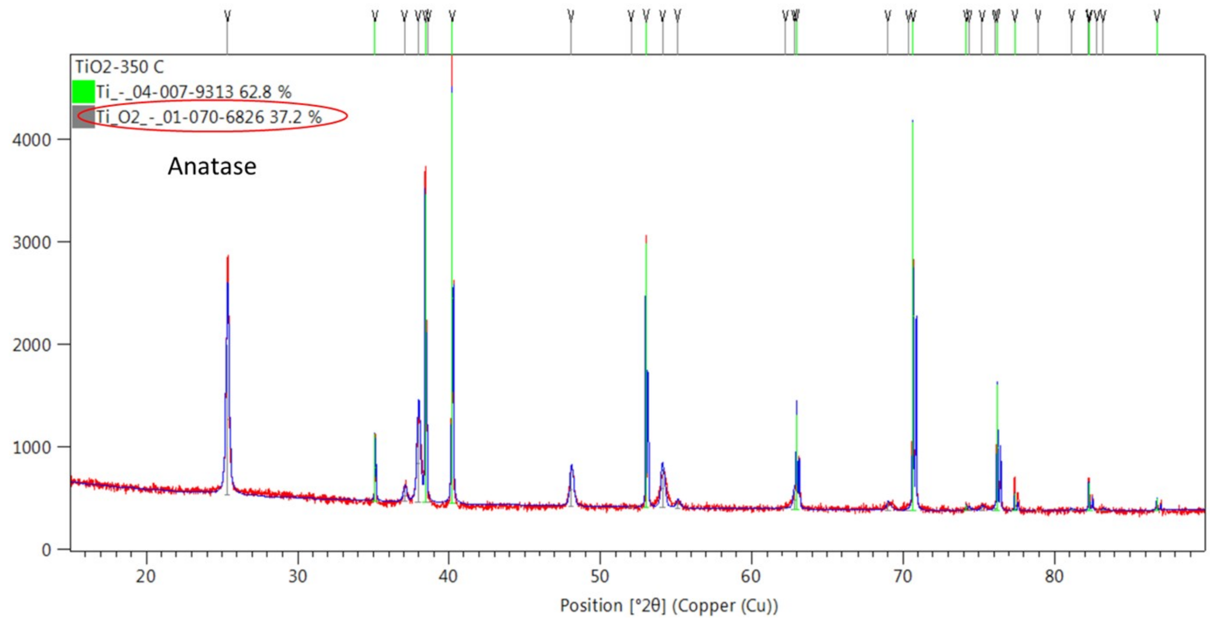

Figure S1. XRD spectrum of the 10 μm-long TiO_2 NT/Ti sample.

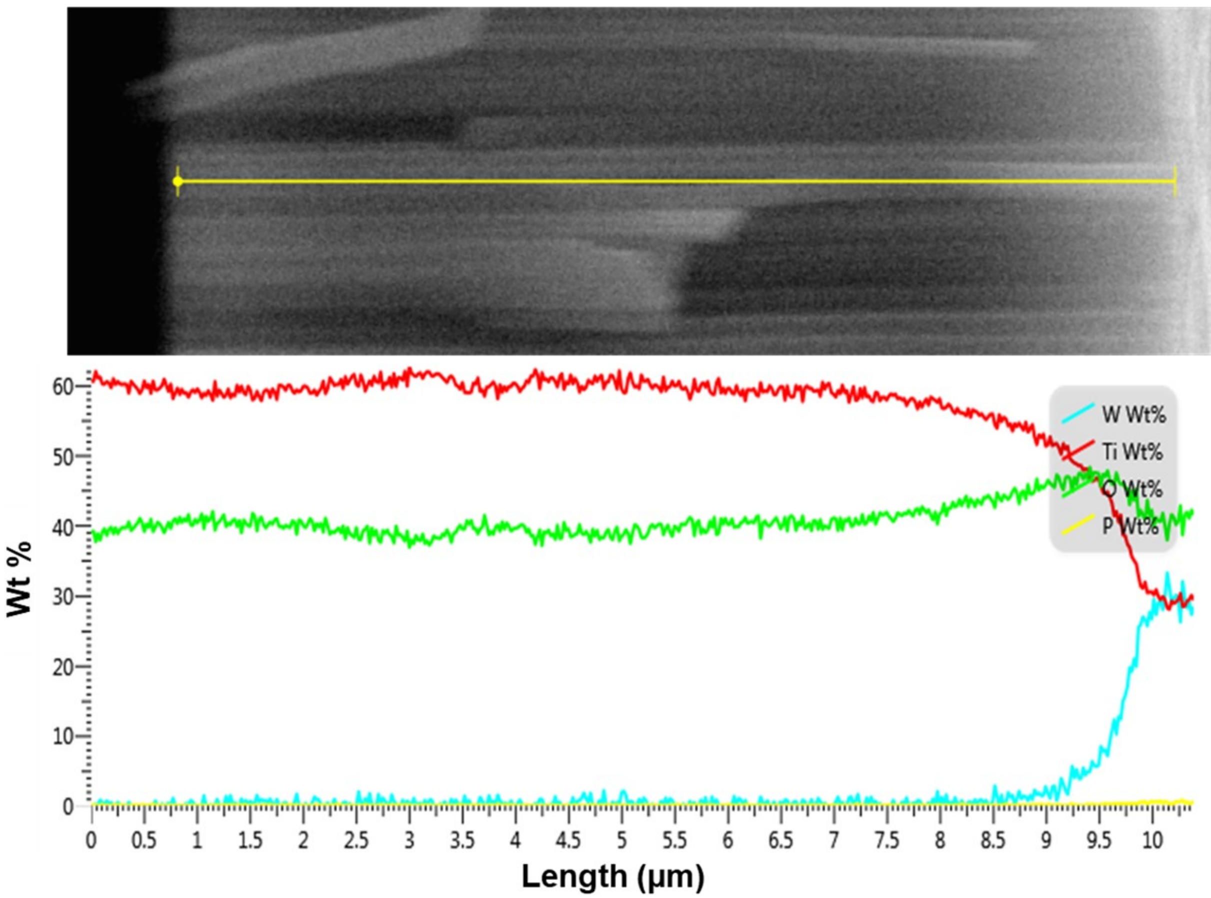

Figure S2. EDX line scans across the length of WPOM/TiO_2 with the coverage of 6.2⨯14 ions (960 ng). The results are expressed in terms of weight percentages (Wt%) of the elements

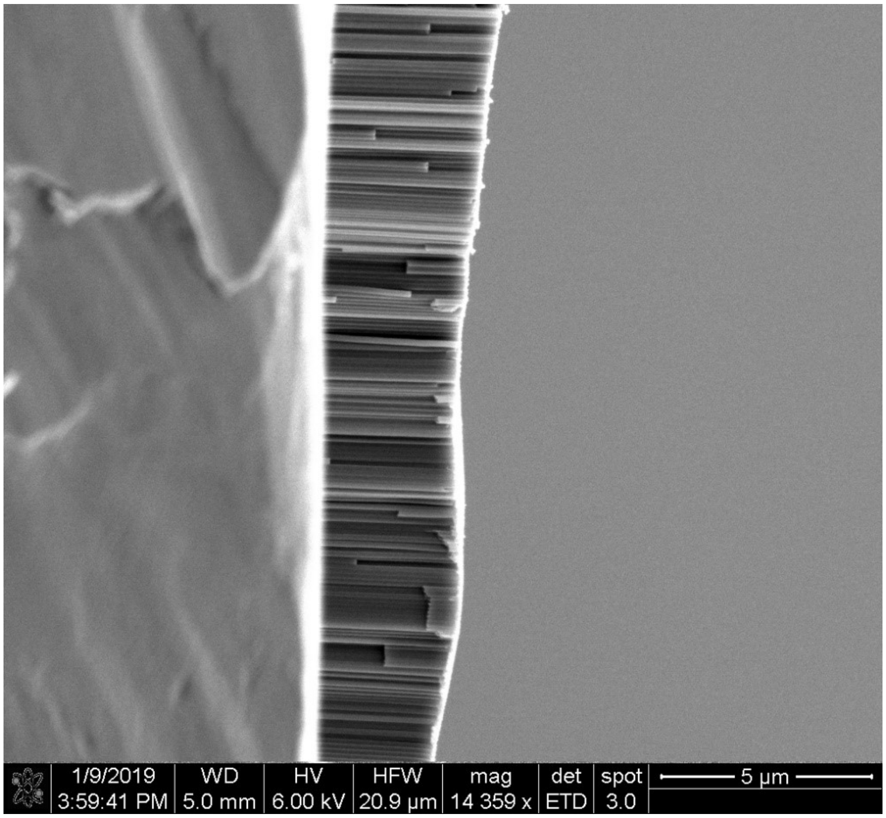

Figure S3. SEM image of 6 µm WPOM/TiO_2 NTs attached to the Ti substrate.

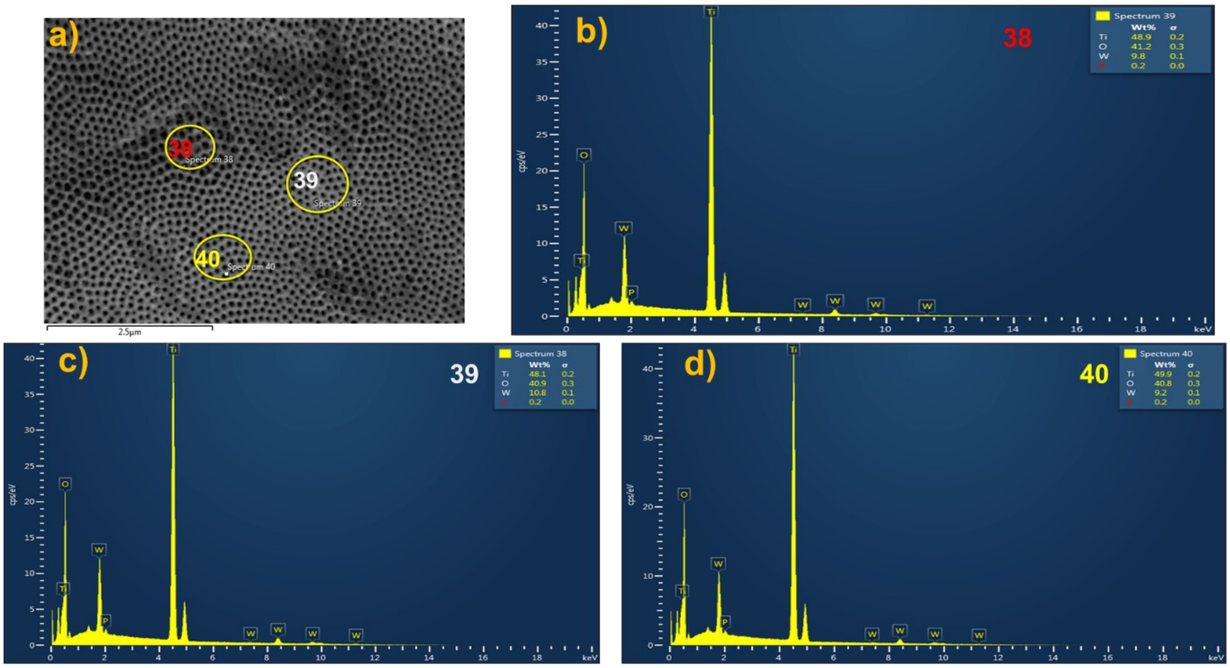

Figure S4. (a) SEM image of the TiO_2/WPOM sample and (a,b,c) is the EDX spectra of the sample at point 38, 39, and 40.

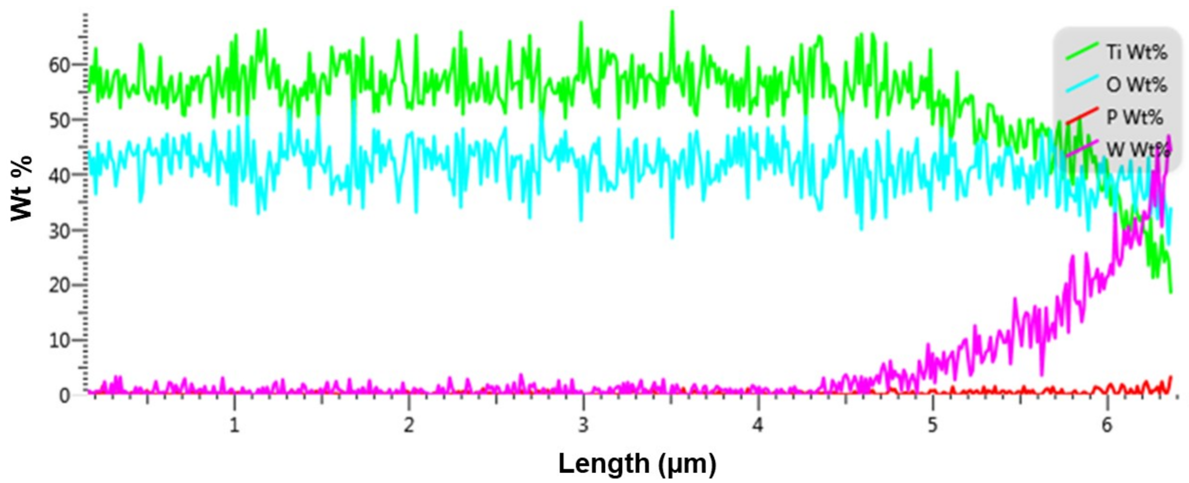

Figure S5. EDX line scans across the short TiO_2 NTs (6 μm)/ with the coverage of 3.0✗ 14 ions (480 ng). The results are expressed in terms of weight percentages (Wt%) of the elements.

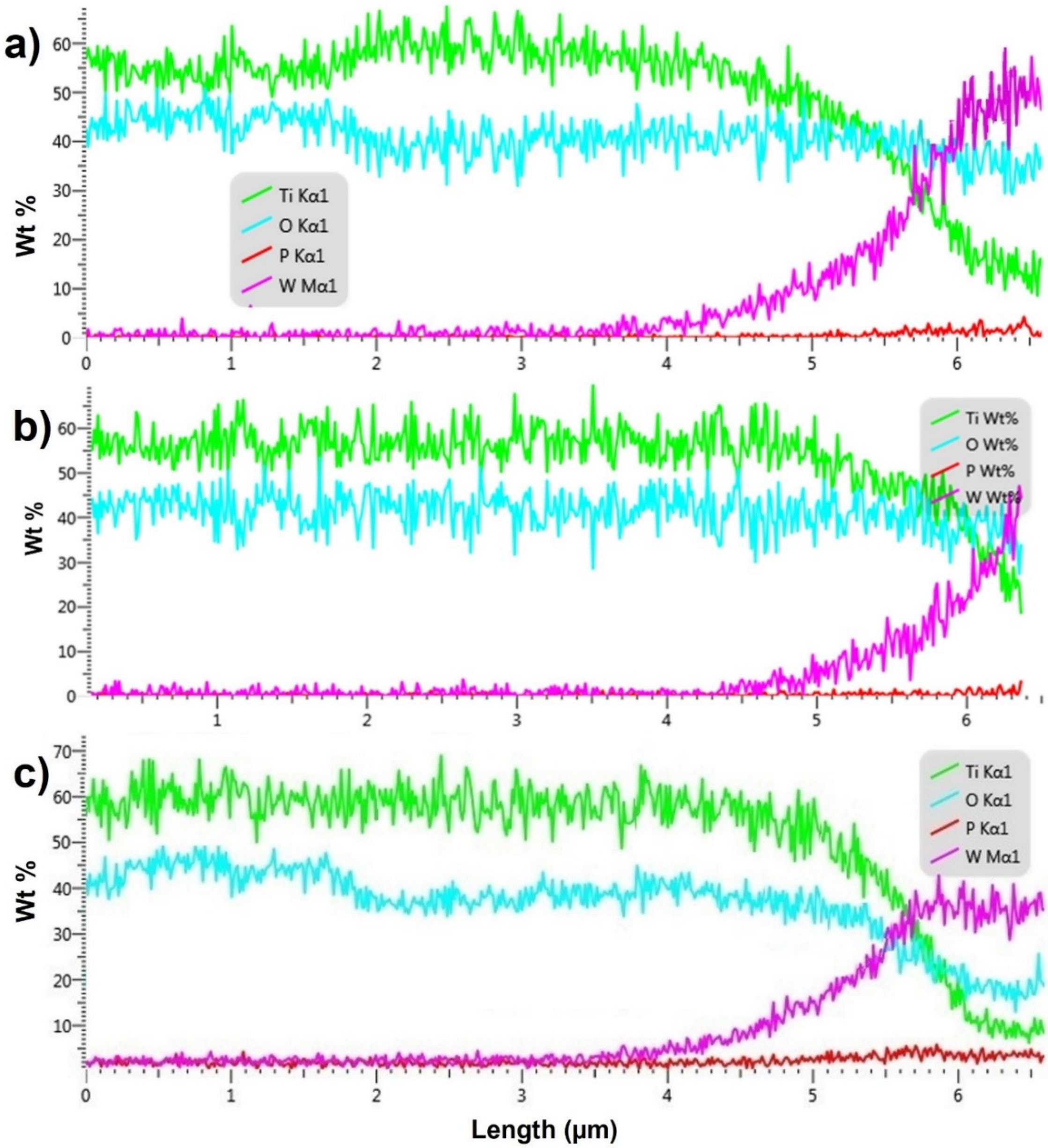

Figure S6. EDX line scan profile of 6 μm TiO_2/WPOM at different region of the TiO_2 cross section.

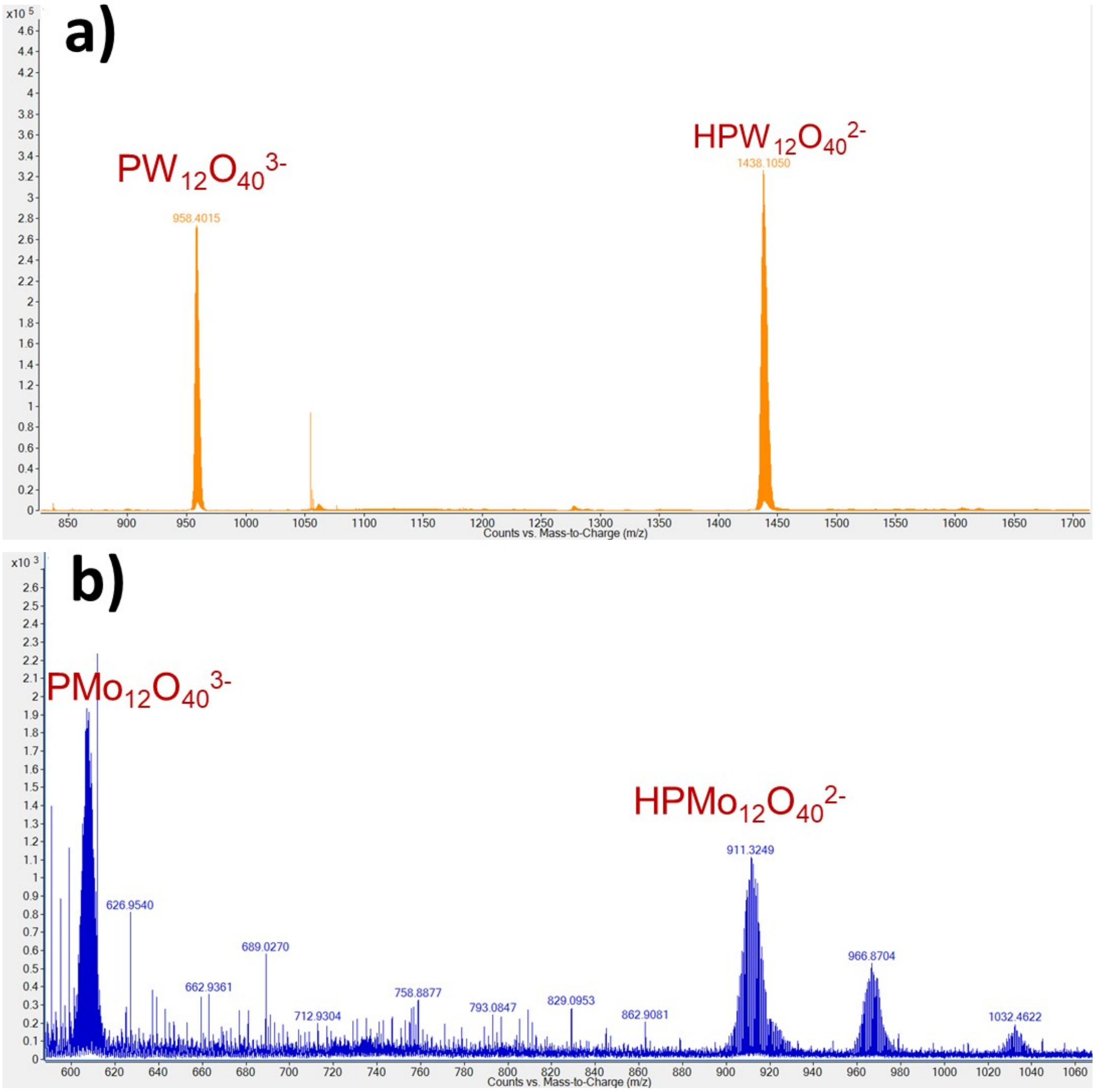

Figure S7. (a) mass spectrum of the TiO_2/WPOM sample with the coverage of 1.0×10^{14} ions and (b) mas spectrum of the VACNT/MoPOM with the coverage of 1.0×10^{14}.

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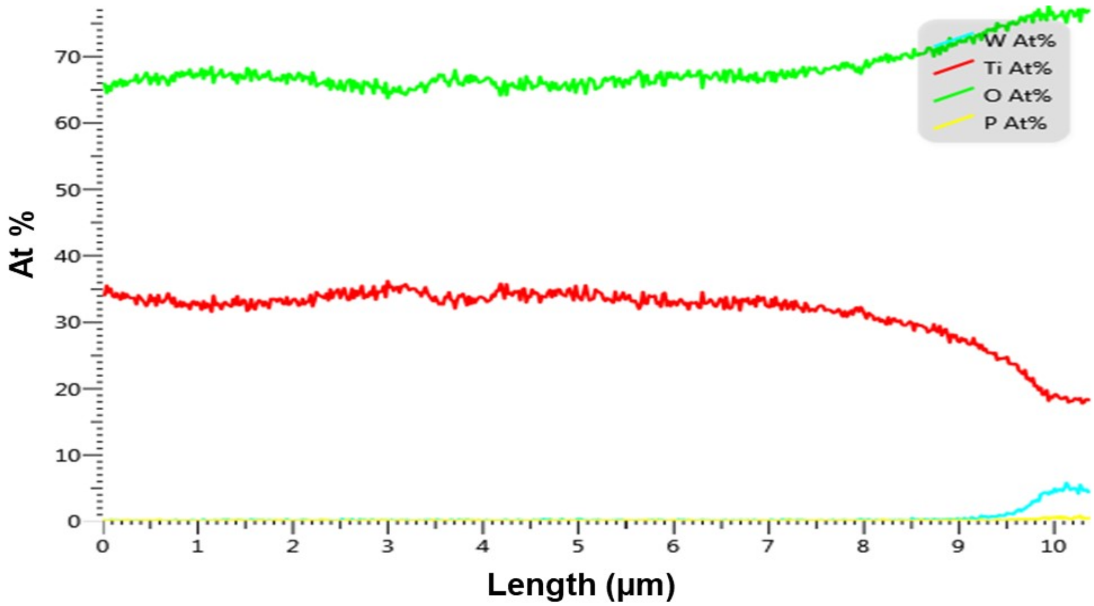

Figure S8. EDX line scans across the length of pristine WPOM/TiO_2 with the coverage of 6.2× 10^{14} ions (980 ng). The results are expressed in terms of atomic percentages (At%) of the elements.

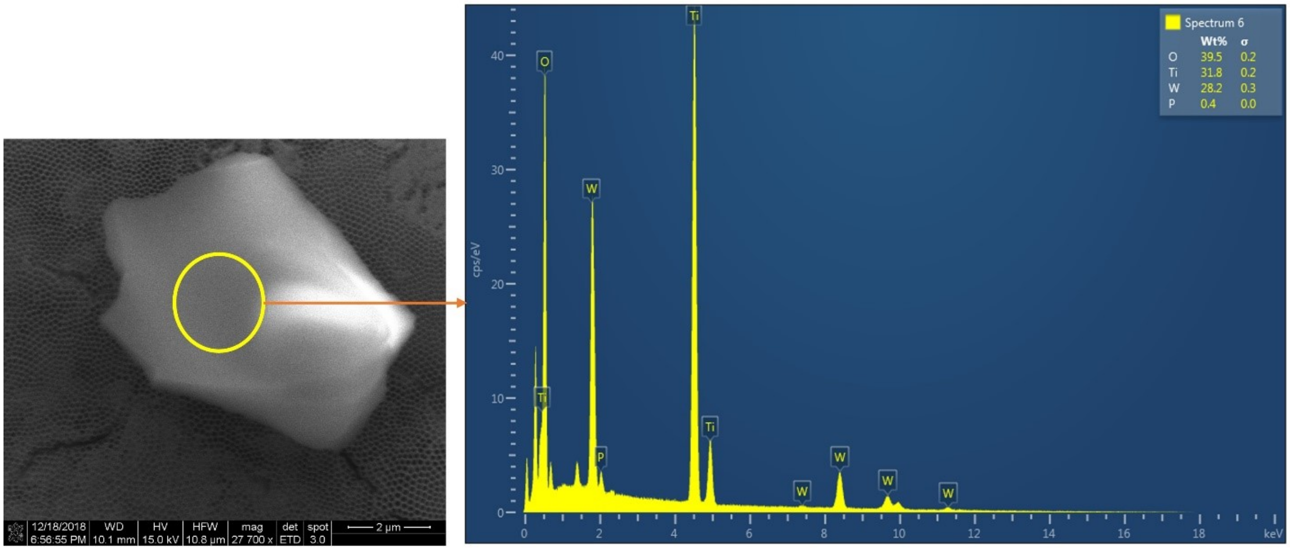

Figure S9. SEM image of the WPOM/TiO_2 with the coverage of 6.2×10^{14} ions (960 ng) and the EDX spectrum of the aggregated anions on the surface.

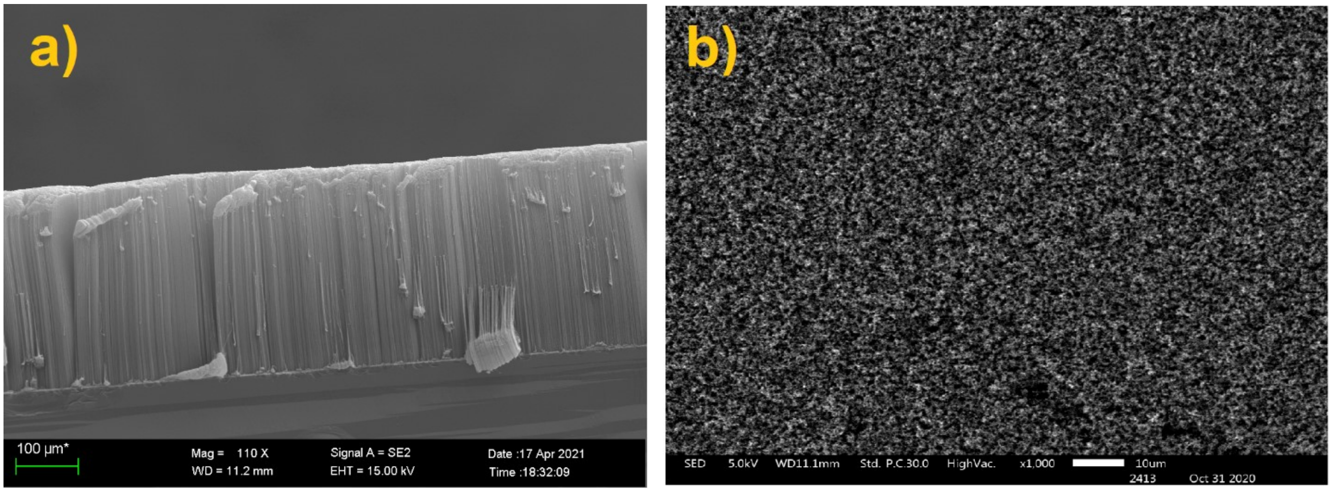

Figure S10. (a) side view and (b) top view of VACNT before soft landing anions.

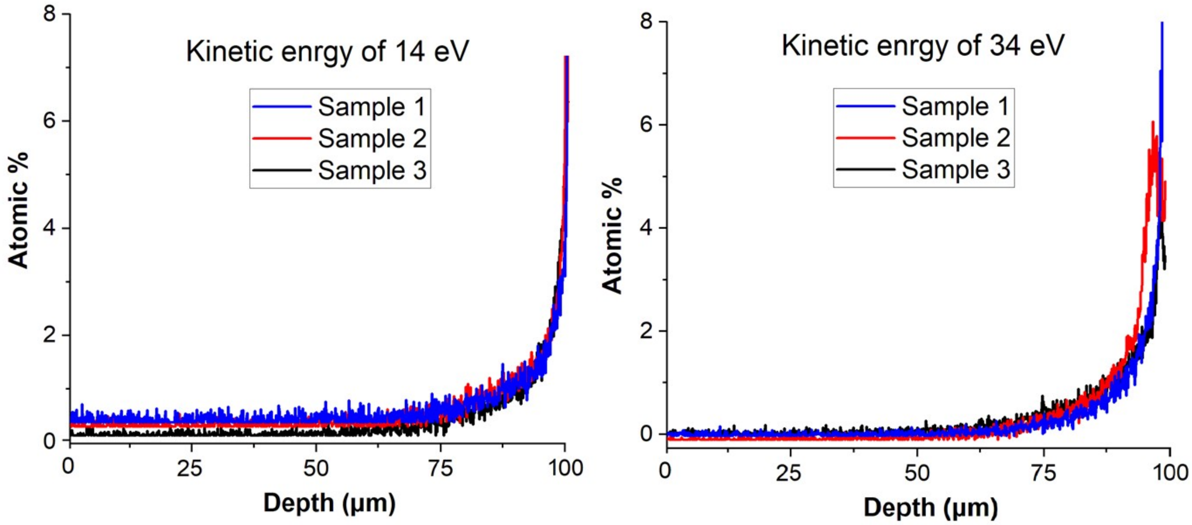

Figure S11. EDX line scan profile of VACNT/MoPOM samples with the coverage of 1.0 $\times 10^{14}$ ions and KE of (a)14 eV (b) 34 eV

Calculation of ion coverage

We measure the image current using picoamp meter (I). Based on the measured image current we calculate number of the soft-landed ions on a surface.

The image current measured in the soft landing experiment was ~6 nA/S:

Measured Ion current (I) × time (S) × charge generated by one mol of triply charged anion (POM) × # of anions in 1mol = **coverage of anions**

$$6.0\times10^{-9}\ \text{C/S} \times \left(400\ \text{min} \times \frac{60\ S}{1min}\right) \times \frac{1mol\ ion}{(96352\ C)\times 3} \times \frac{6.022\times 1023}{1mol\ ion} = 3.0\times10^{14}\ \#\ \text{of anions}$$

$Q=n\times e = 6.022\times10^{23}\times 1.6\times10^{-19} = 96352C$

Q: charge of 1 mol electron

e: charge on 1 electron= 1.6×10^{-19}

Calculation of number of monolayers (ML) on surfaces

The average diameter of the ion beam was approximately 5 mm. r1=2.50 mm

Deposition area: $A = \pi r1^2$

We assume that the radius of the WPOM anions is 0.9 nm. R2=0.9 nm

Ratio of the area covered by each ion: $\frac{\pi r2^2}{\pi r1^2} = \left(\frac{9.0\times 10-7}{2.50}\right)^2 = 12.9\times10^{-14}$

This means that one ion covers 12.96×10^{-12} % of the monolayer of the total area.

Therefore 100% of a monolayer will require $1.29\times10^{13} \approx 1.3\times10^{13}$ ions.

In the samples with the coverage of 3.0×10^{14} ions, there will be 23 monolayers.

Estimated ion flux per unit time per area corresponding to a single TiO2 NT (100 nm in diameter)

- Deposition current= 6 nA= 6.0×10^{-9} C/s
- Area corresponding to a single TiO2 NT (100 nm diameter, r=50 nm)= $A = \pi r^2$
- Ion flux per unit time per area corresponding to a single TiO2 NT (100 nm diameter) =

$$\frac{6.0\times 10-9\ C/s}{A} = 0.0764\times10^{5}\ \text{C/s.m}^2 = 0.00764\ \text{C/µs. m}^2$$

Table1. List of voltages on the ion soft-landing instrument for depositing POM anions.

Ion optics component	**Voltages (V)**
Repel in	385
Repel out	380
HPF in	331
HPF out	160
LPF in	163
LPF out	16
HPF Drive	22.6
LPF Drive	24.7
HPF Freq	690000 Hz
LPF Freq	912000 Hz
Bent flatapole	32 V

HPF: High pressure funnel

LPF: Low pressure funnel