Supporting Information

Alkali metals incorporated ordered mesoporous tantalum oxide with enhanced photocatalytic activity for water splitting

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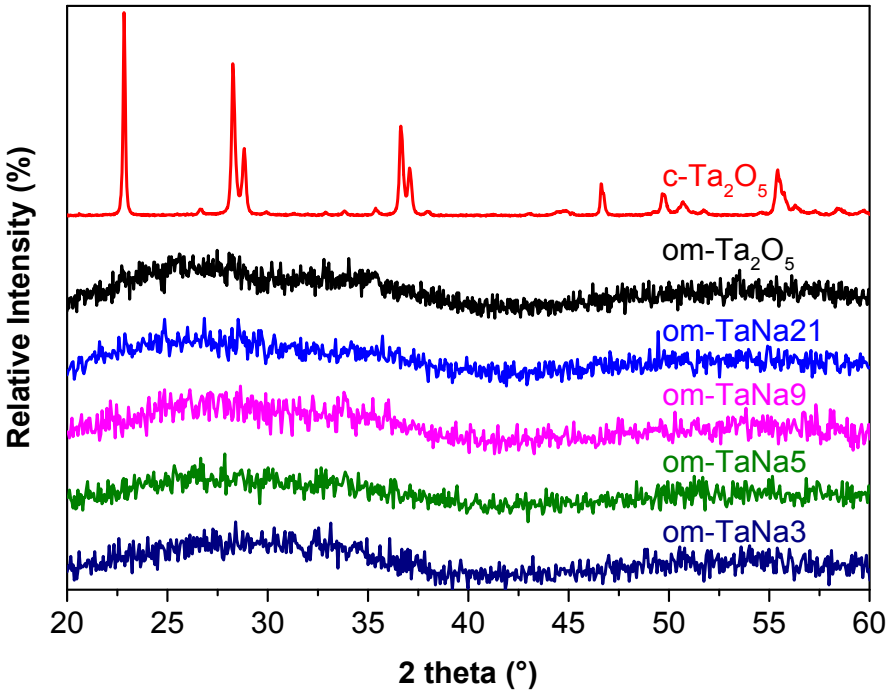
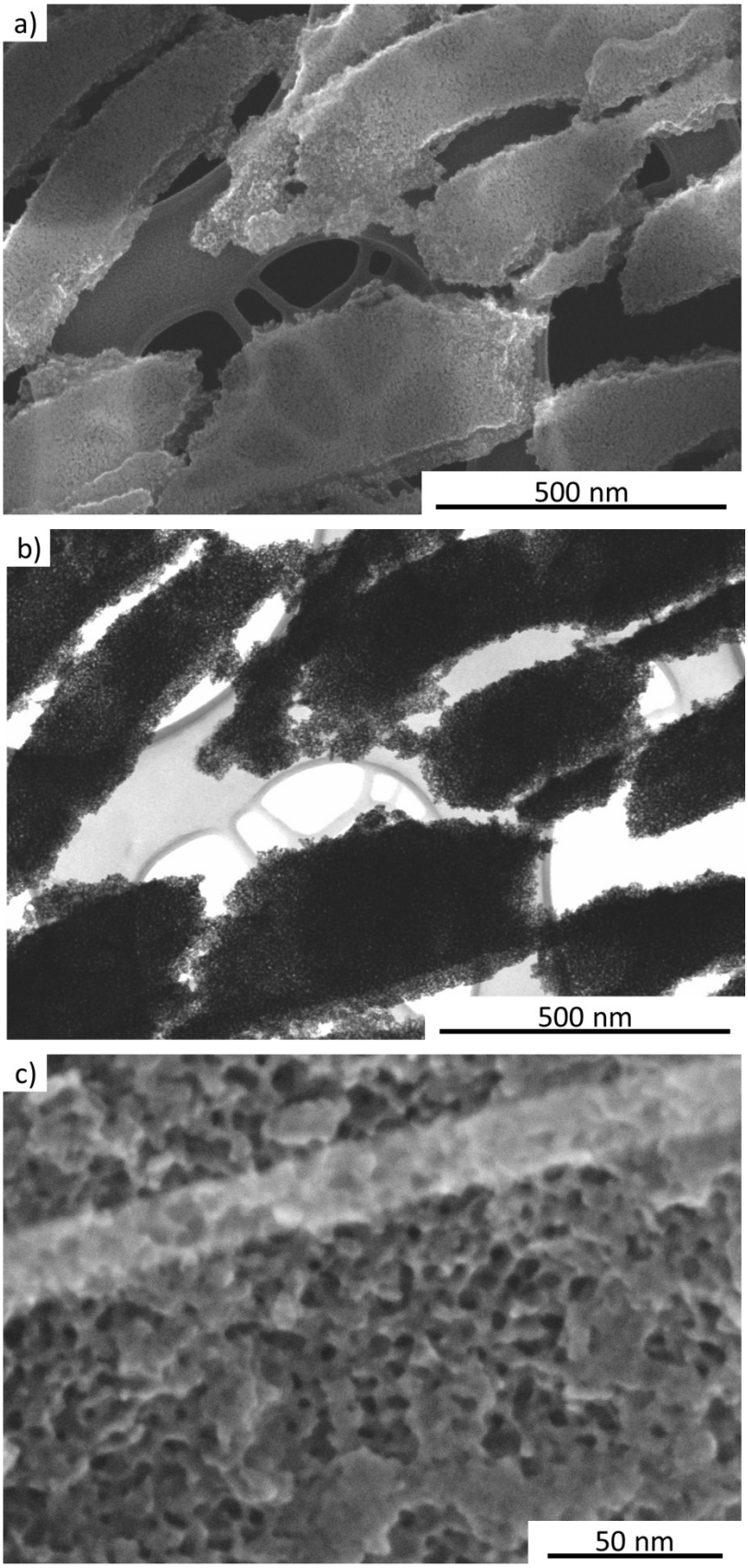


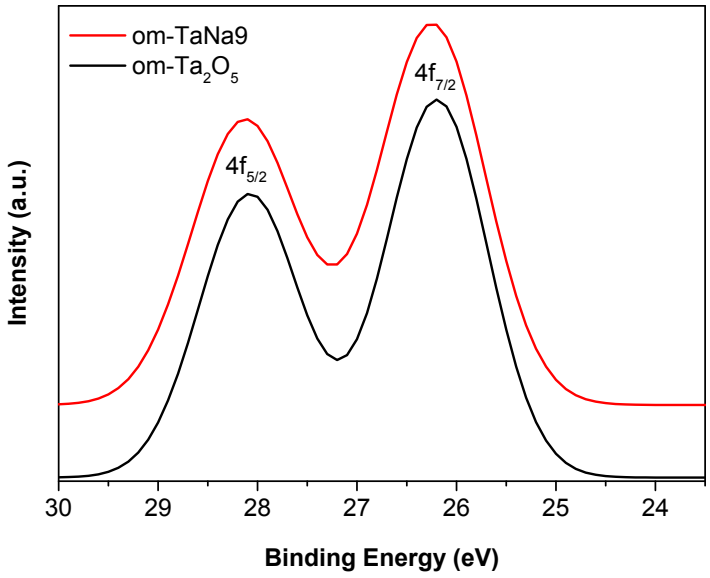
SI Figure 1. XRD patterns of om-Ta_2O_5 and sodium loaded samples om-TaNa21, om-TaNa9, om-TaNa5 and om-TaNa3. For comparison, the XRD pattern of the commercial reference sample c-Ta_2O_5 is shown as well. The abbreviation *om-* and *c-* represent *ordered mesoporous* and *commercial*, respectively.

SI Table 1. EDX analysis data of the om-TaNa sample series. The abbreviation *om-* represents *ordered mesoporous*.

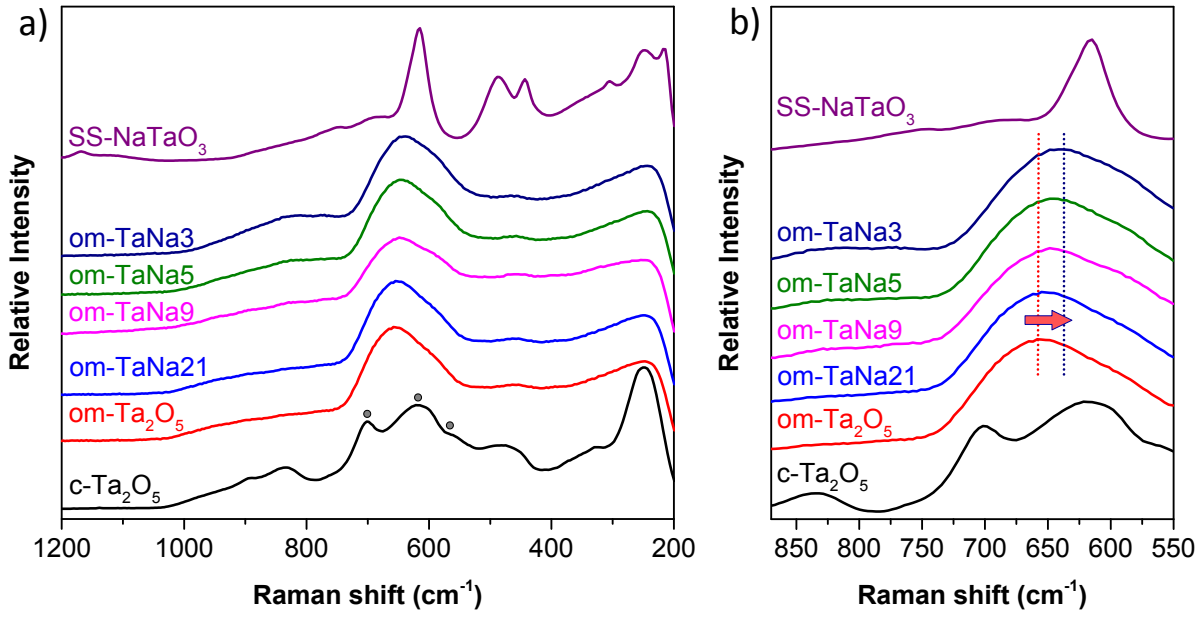
Sample	Atom-%		Ta/Na ratio
	Ta	Na	
om-TaNa21	96.1	3.9	24.6
om-TaNa9	90.4	9.6	9.4
om-TaNa5	87.0	13.0	6.7
om-TaNa3	77.8	22.2	3.5



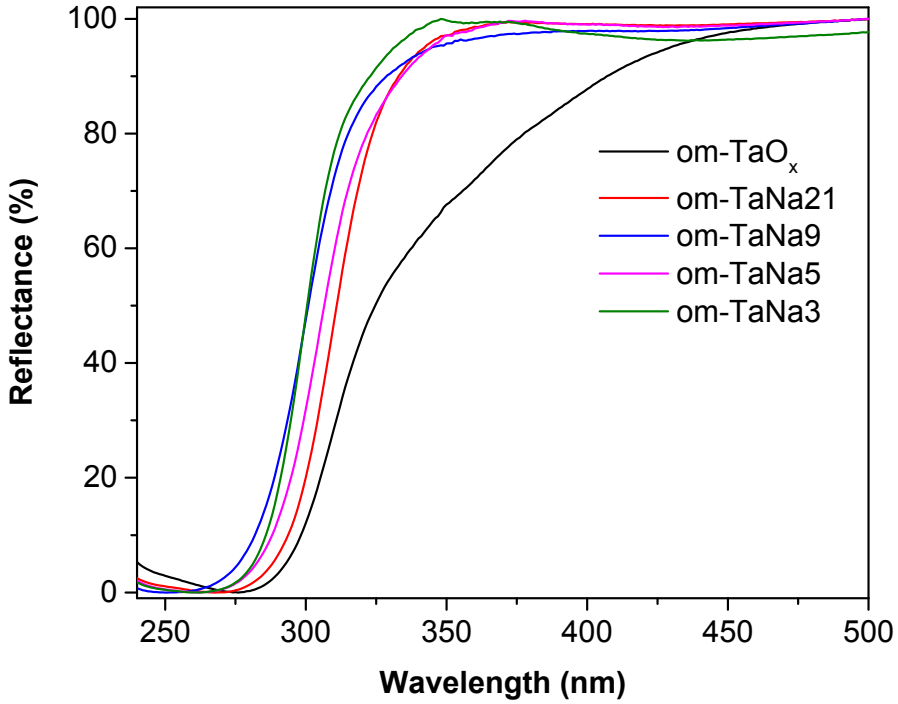
SI Figure 2. (a) Cross-sectional SEM image and (b) an image in bright field STEM mode of the same area of of om-TaNa9; (c) SEM image of the surface of om-NaTa9.



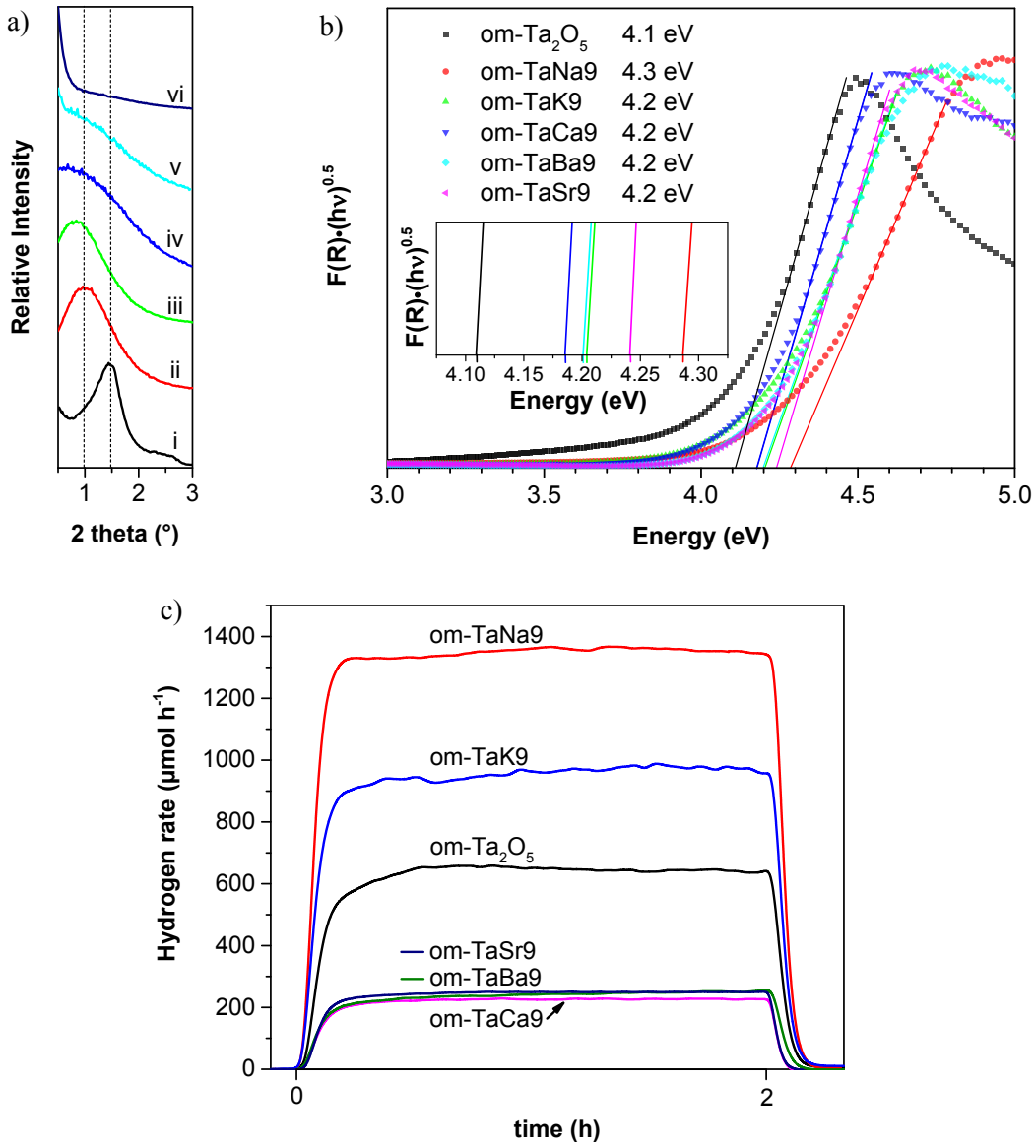
SI Figure 3. XPS spectra of Ta 4f binding energies of om-Ta_2O_5 and om-TaNa9. The abbreviation *om-* represents *ordered mesoporous*.



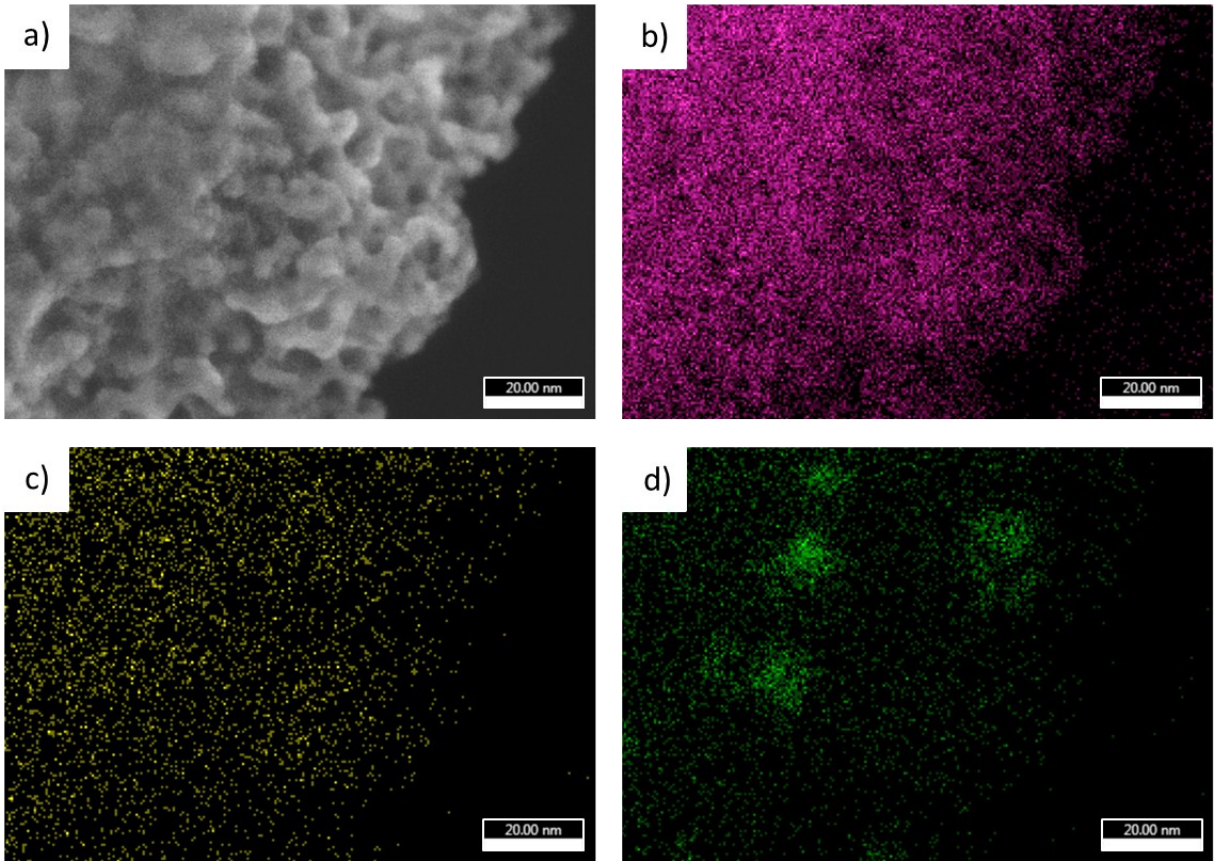
SI Figure 4. Raman spectroscopy data of the om-TaNa sample series and reference samples. (a) An overview of the measured spectra shows the position of the bands for all samples. The circles in the spectrum of c-Ta_2O_5 indicate the triply split peaks of the TaO_6 octahedron. (b) In a higher resolution, the shift of the main TaO_6 mode is depicted. The abbreviation *om-*, *c-* and *SS-* represent *ordered mesoporous, commercial* and *solid state* respectively.



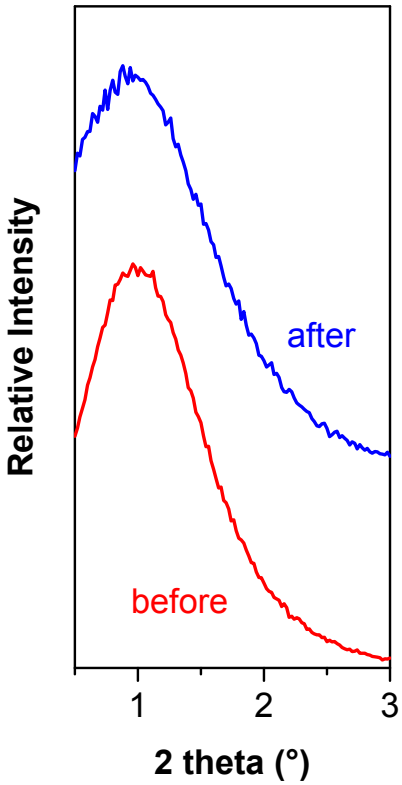
SI Figure 5. Diffuse reflectance UV-Vis spectra of om-Ta_2O_5 and sodium loaded samples. The abbreviation *om-* represents *ordered mesoporous*.



SI Figure 6. (a) Low angle XRD patterns of (*i*) om-Ta_2O_5, (*ii*) om-TaNa9, (*iii*) om-TaK9, (*iv*) om-TaCa9, (*v*) om-TaBa9 and (*vi*) om-TaSr9. (b) Tauc plots (inset: close-up of intersection with x-axis) and (c) hydrogen evolution rates of om-Ta_2O_5 and om-TaX9 with x = Na, K, Ca, Ba and Sr. Hydrogen evolution was tested in 10 vol-% methanol/water solution. The abbreviation *om-* represents *ordered mesoporous*.



SI Figure 7. STEM study of om-TaNa9 with 5 wt-% NiO_x loading, including elemental mapping; (a) SE image of the region of interest; elemental distribution of (b) Ta, (c) Na, and (d) Ni. The abbreviation *om-* represents *ordered mesoporous*. EDX analysis of this sample gave atomic ratios of Ta/Na = 10.1 (9.0) and Ta/Ni = 6.6 (7.4). The theoretical values are shown in brackets.



SI Figure 8. Low angle XRD patterns of sodium loaded ordered mesoporous tantalum oxide with Ta/Na ratio of 9 (om-TaNa9) and 2.5 wt-% NiO_x measured before and after overall water splitting. The sample was irradiated in the reactor for 30 h in total.