Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

SUPPLEMENTARY INFORMATION

Engineering kinetics and interfacial energetics of Ni/Ni–Mo catalyzed amorphous silicon carbide photocathodes in alkaline media

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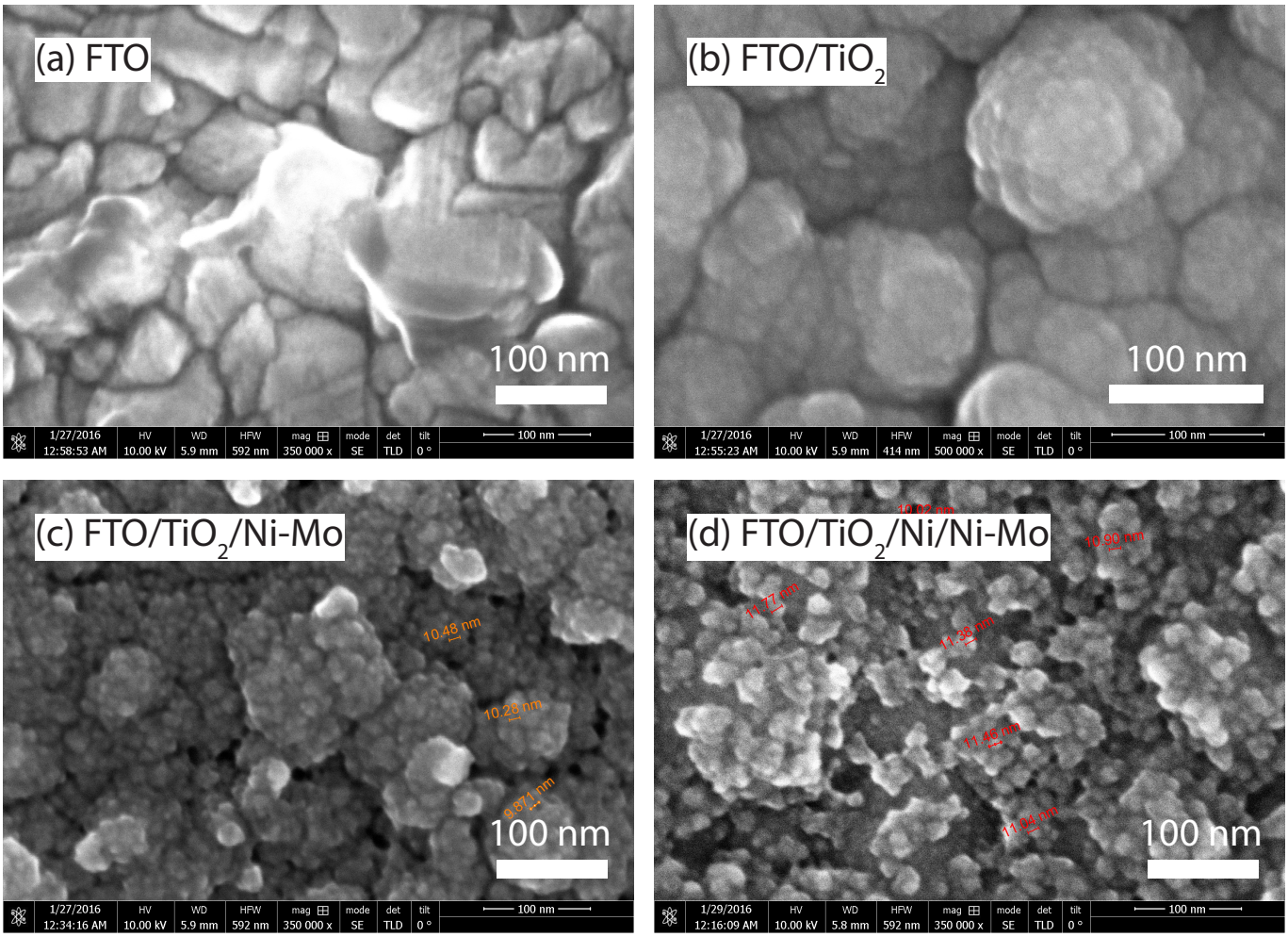

Fig. S1 Scanning electron microscopy (SEM) images of FTO, FTO/TiO_2, FTO/TiO_2/Ni–Mo, FTO/TiO_2/Ni/Ni–Mo.

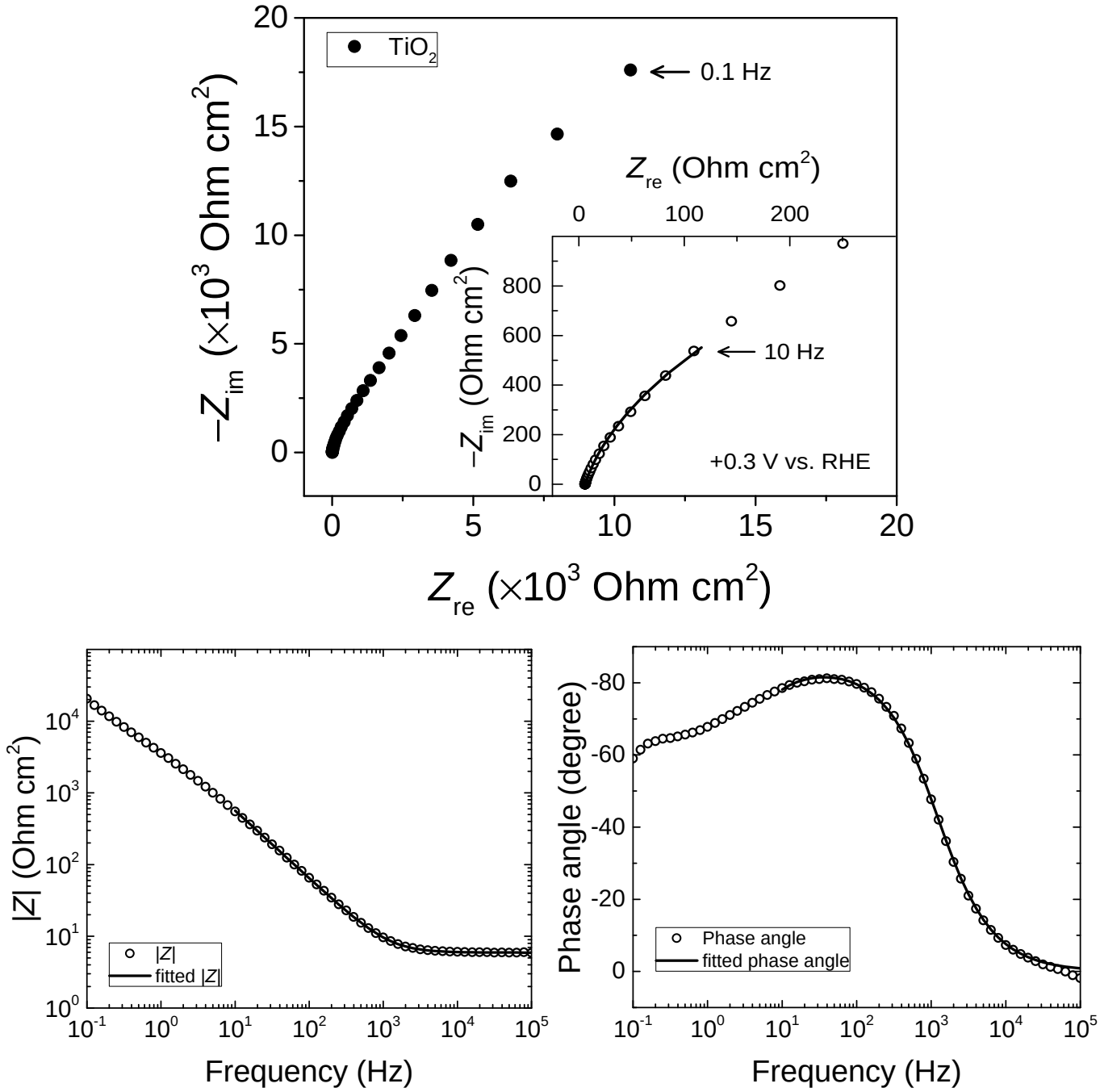

Fig. S2 (top) Nyquist plot, (bottom left) bode plots of total impedance and (bottom right) phase angle of TiO_2 at an applied potential of $+0.3$ V vs. RHE.

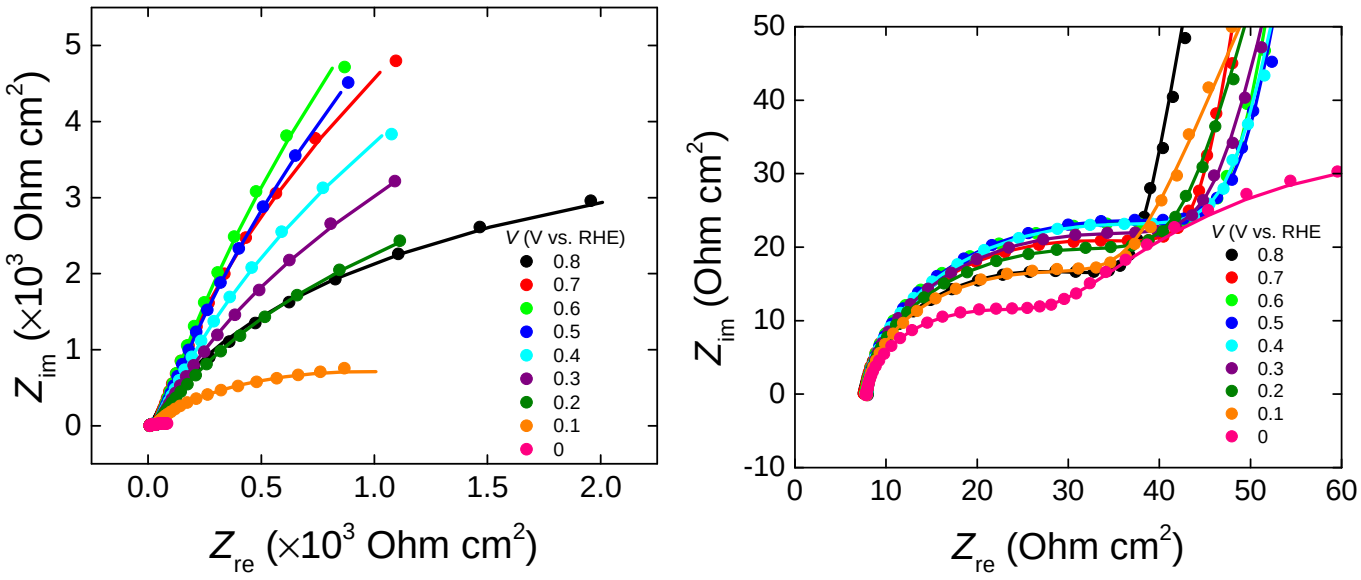

Fig. S3 (left) Nyquist plots of TiO_2/Ni–Mo at various applied potentials. The solid lines represents the fitted impedance data using the equivalent circuit in Fig. 4c. (right) The magnification of figure in the left, showing the fitted high-frequency impedance (*i.e.*, the low semicircles)

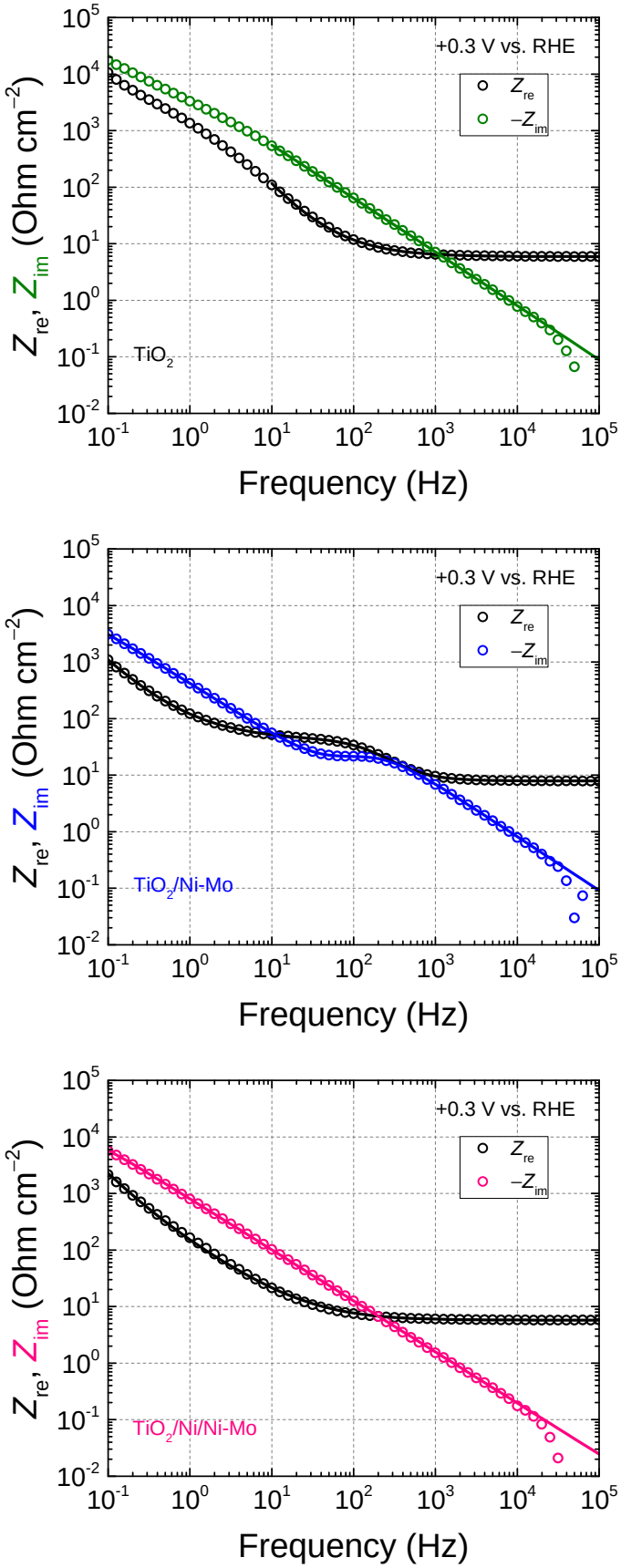

Fig. S4 The real part (Z_{re}) and the imaginary part (Z_{im}) of impedance spectra of TiO_2 with and without the catalysts at an applied potential of $+0.3$ V vs. RHE. The solid lines represent the fitted data using the equivalent electronic circuits

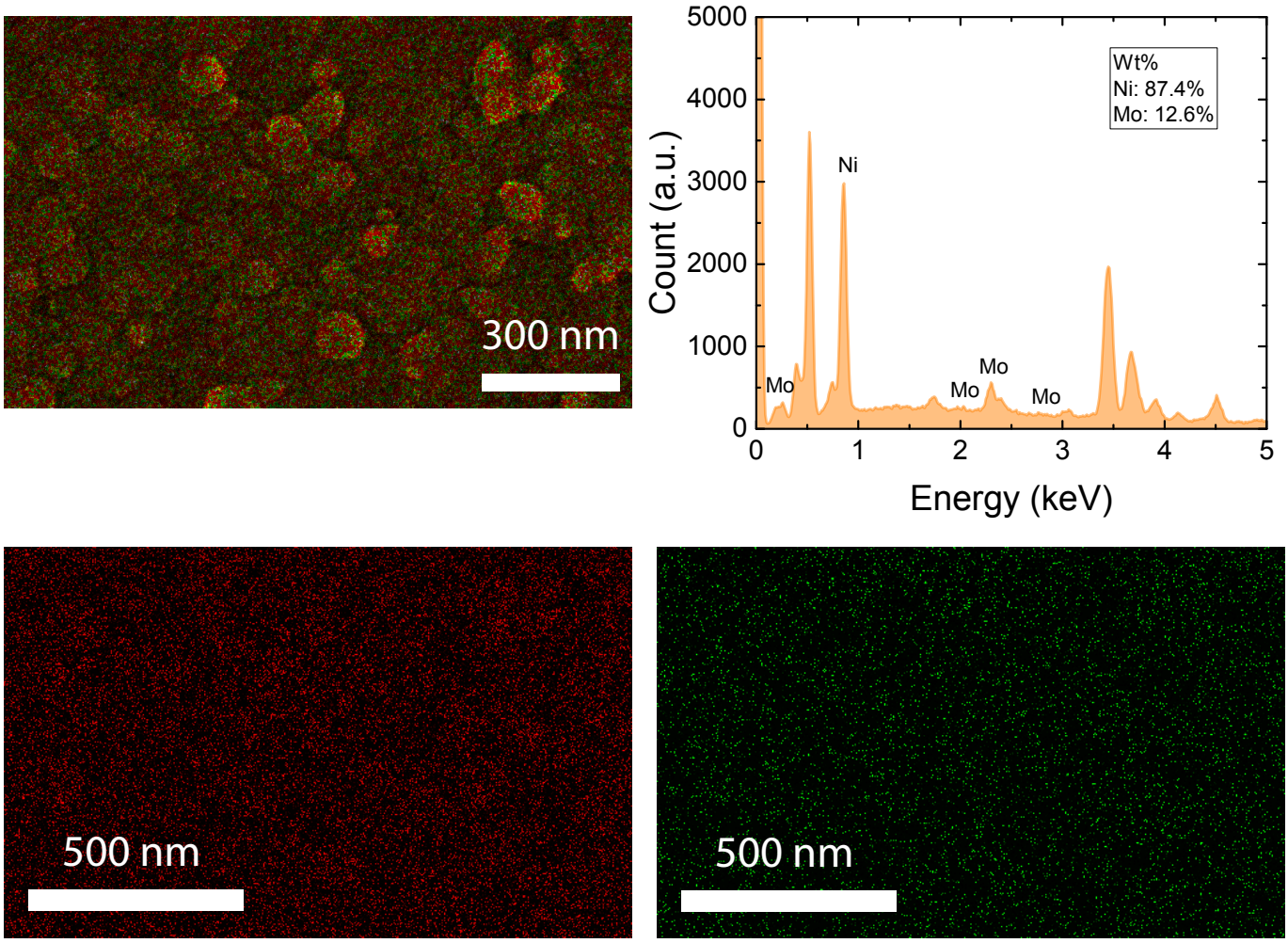

Fig. S5 Energy dispersive X-ray sperctroscopy (EDS) elemental mapping of TiO2 with 2 nm of Ni and Ni-Mo particles.

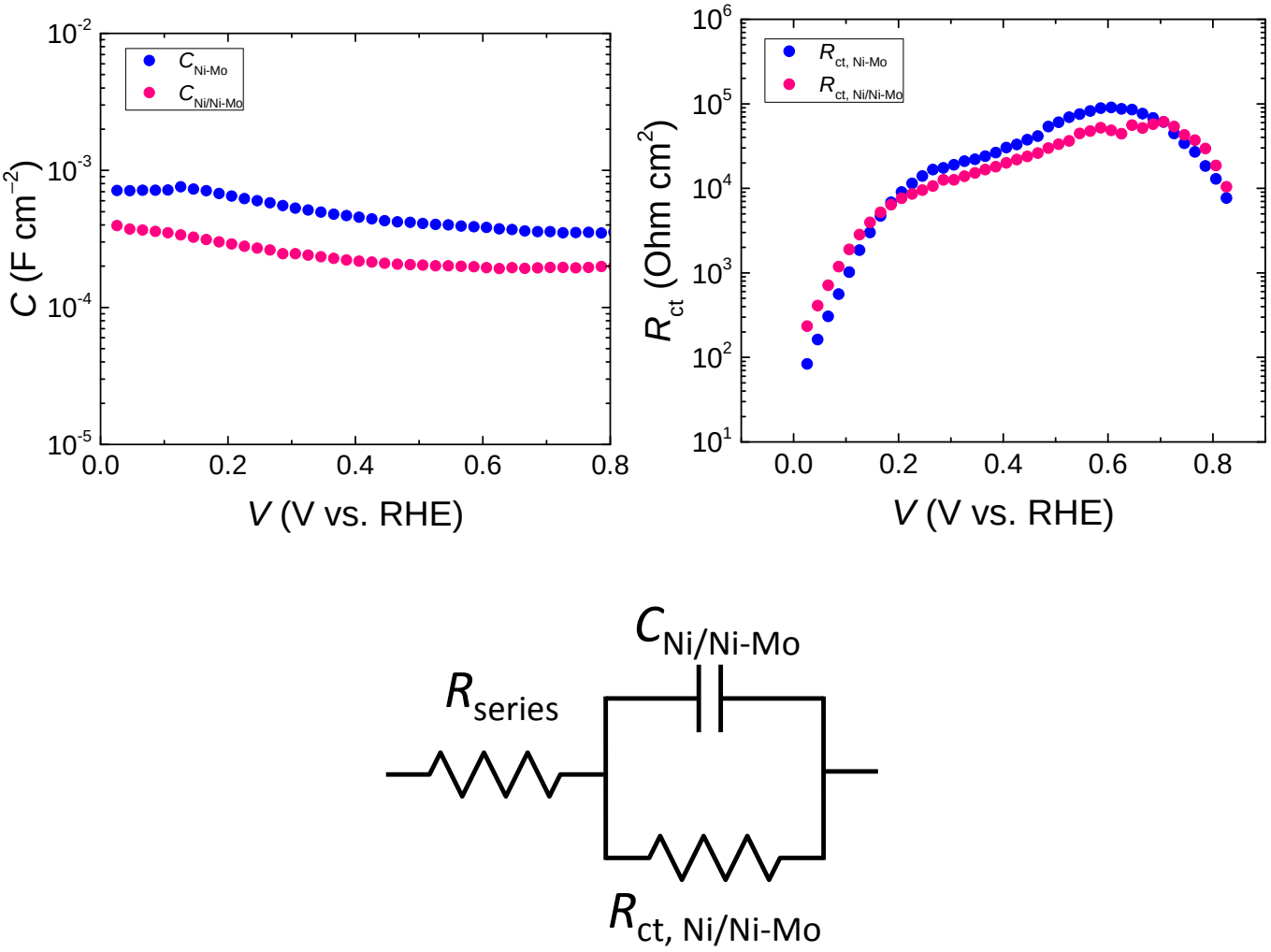

Fig. S6 (top left) Capacitance and (top right) charge transfer resistance of the Ni–Mo and Ni/Ni–Mo. The values are obtained from the fitted impedance data. (bottom) Equivalent circuit to fit the impedance data of TiO_2/Ni/Ni–Mo.

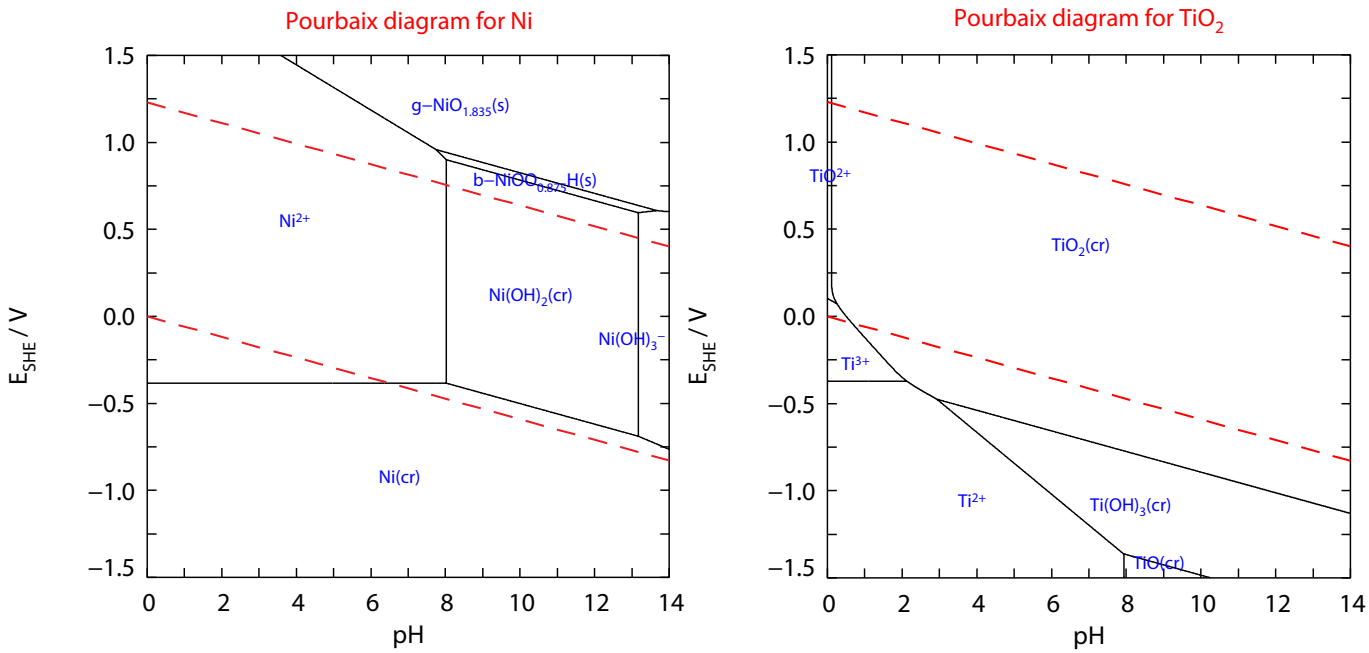

Fig. S7 Pourbaix diagram for Ni (left) and TiO_2 (right) at T = 25 °C, for $[Ni^{2+}]$ = 10 μM, generated using Medusa (`http://www.kth.se/che/medusa/`).

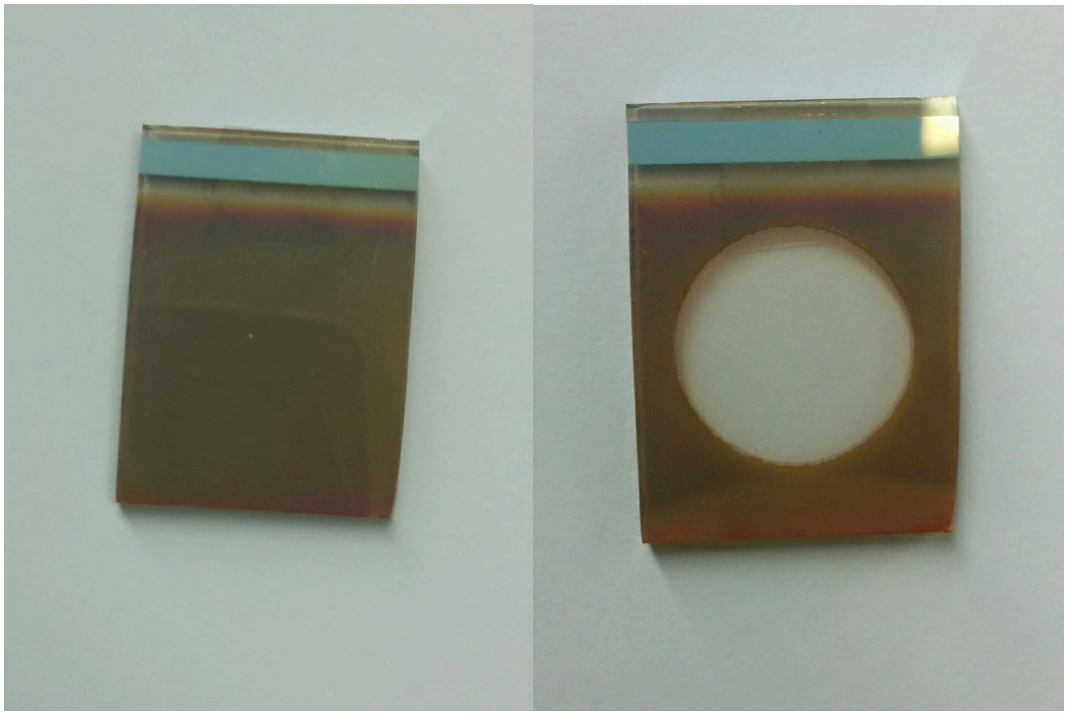

Fig. S8 (left) Photograph of a-SiC without TiO_2 layer and (right) a-SiC after being soaked in 1 M KOH in the dark (no applied bias) for 1 hour. The transparent circular area is the active area that was exposed area to the electrolyte, indicating that a-SiC was completely dissolved after 1 hour.

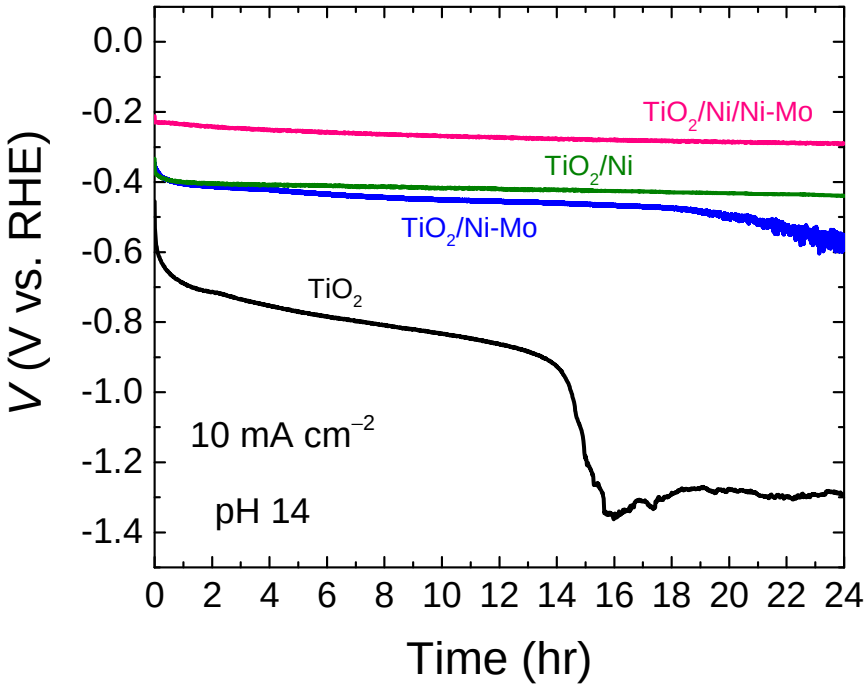

Fig. S9 Chronopotentiomtery test of TiO_2 with catalysts at a fixed applied current of -10 mA cm^2, measured in 1 M KOH at pH 14.

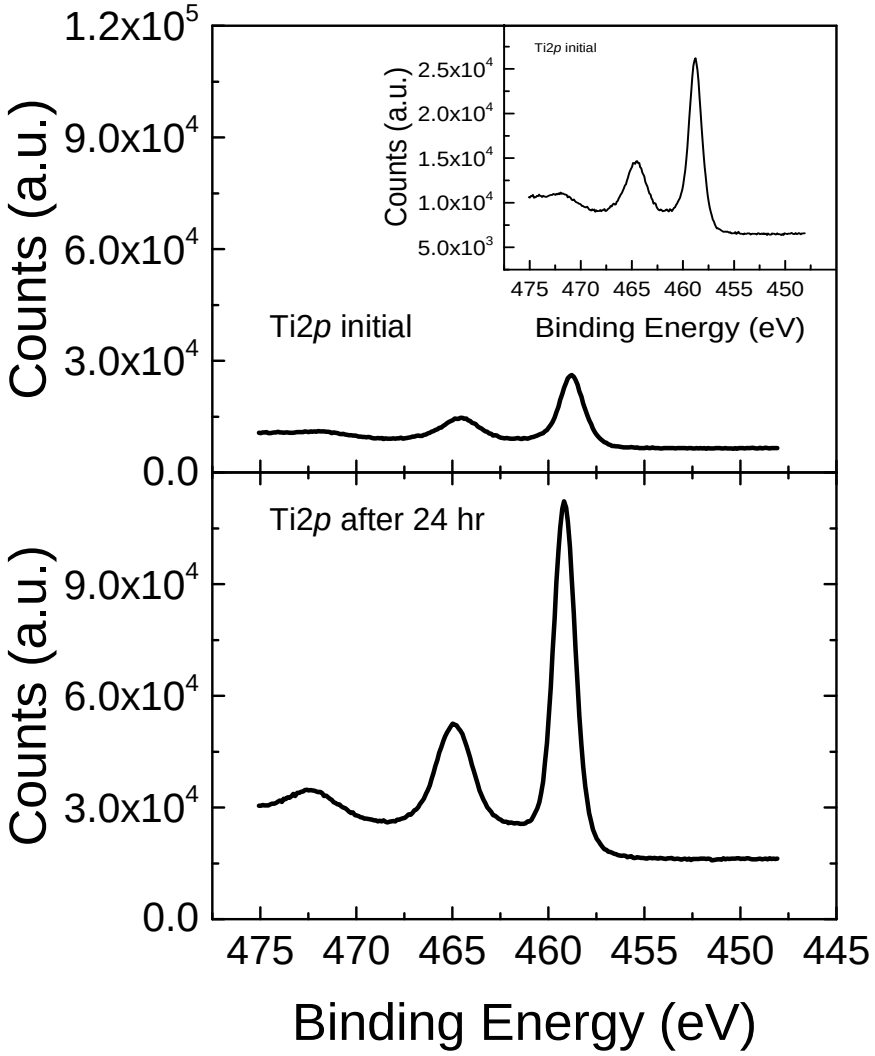

Fig. S10 Ti 2*p* signal from XPS spectra of TiO_2 coated with Ni before (top graph) and after chronopotentiometry test (bottom graph) at a fixed current of -10 mA cm^{-2} for 24 hours. The XPS spectra shows a weaker Ti 2*p* signal before the chronopotentiometry measurement because the TiO_2 is still covered by Ni.

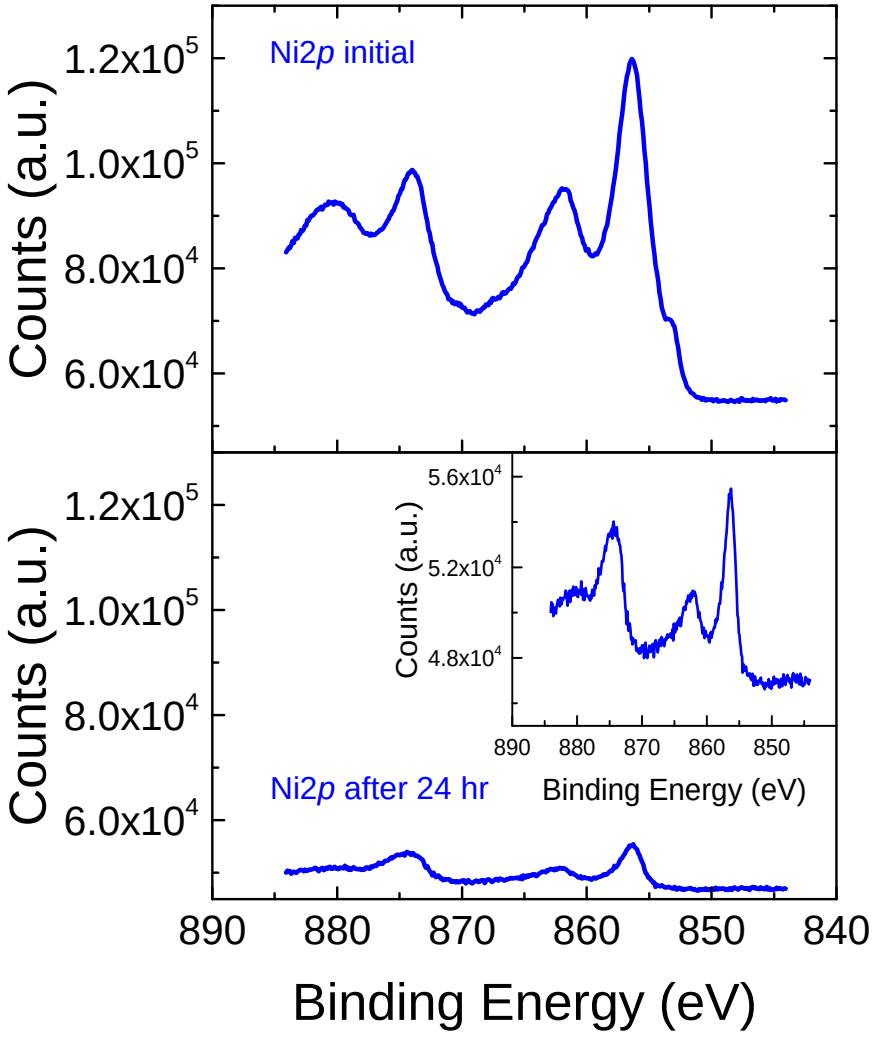

Fig. S11 Ni 2*p* signal from XPS spectra of TiO_2 coated with Ni before (top graph) and after chronopotentiometry test (bottom graph) at a fixed current of -10 mA cm^{-2} for 24 hours. The Ni 2*p* signal is weaker after the 24-hour measurement because the Ni was detached from TiO_2 during the test.

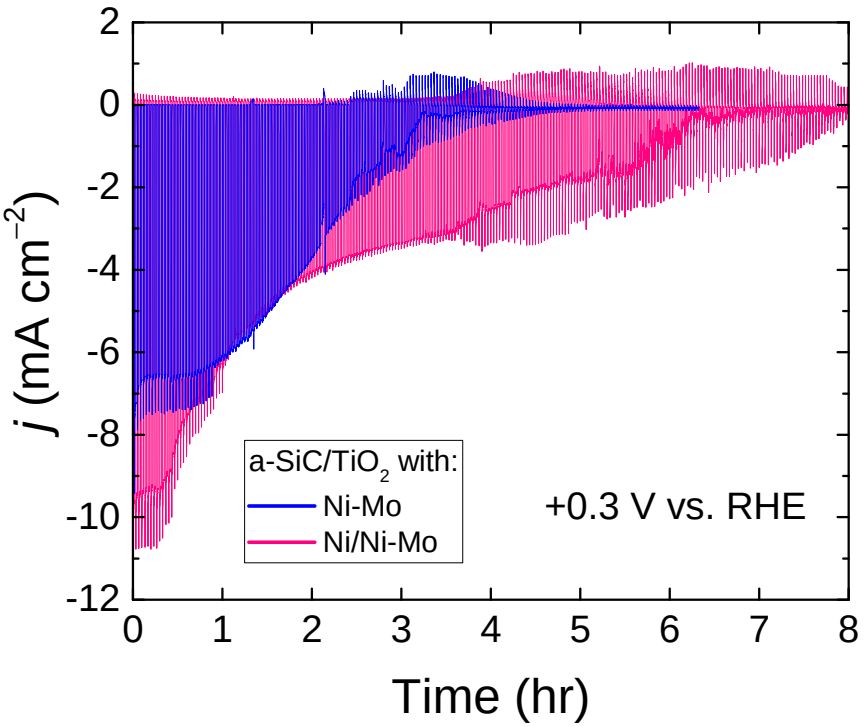

Fig. S12 Chronoamperometry test of a-SiC/TiO_2 with Ni-Mo and Ni/Ni-Mo catalysts at an applied potential of $+0.3$ V vs. RHE, measured under chopped illumination in 1 M KOH electrolyte at pH 14.

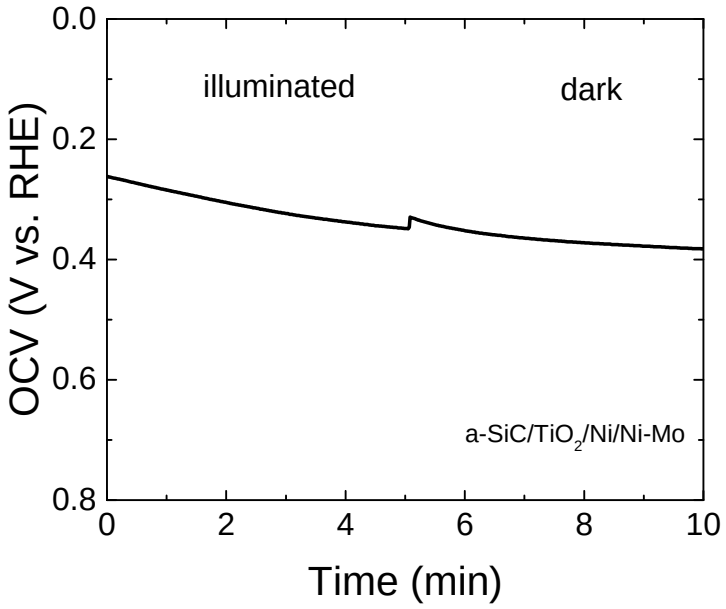

Fig. S13 Open circuit voltage of a-SiC/TiO_2 annealed at 400 °C in vacuum, measured in the dark and under illumination, showing no photovoltage.

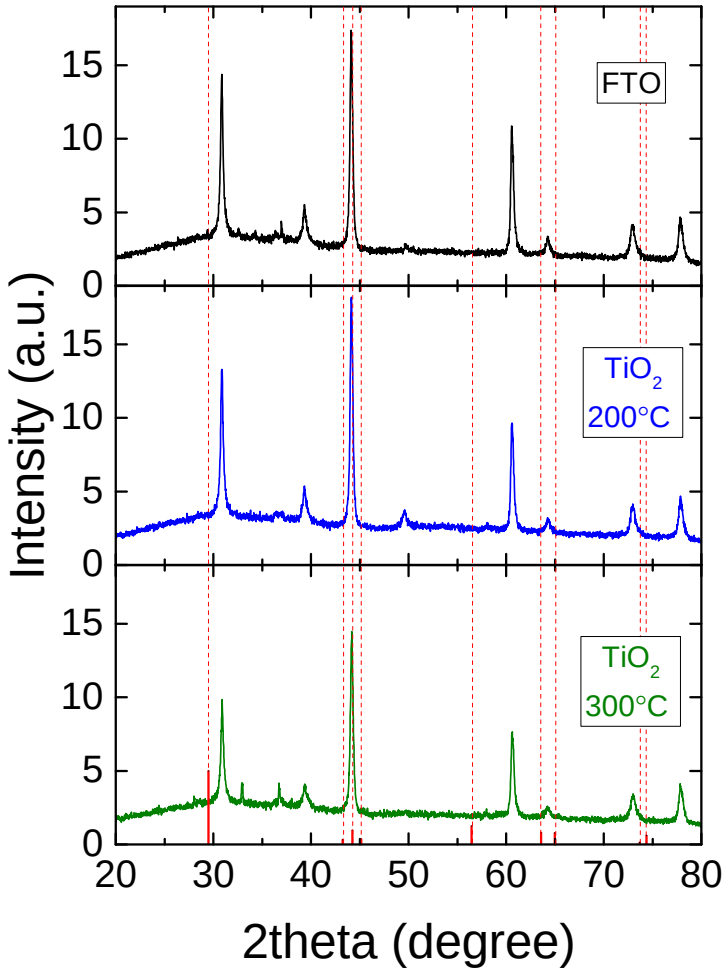

Fig. S14 X-ray diffractogram (XRD) of ALD TiO_2 deposited on FTO substrate at 200 °C and 300 °C. For comparison, the XRD of the FTO is shown. The red dash lines indicate the peak locations of crystalline anatase TiO_2.

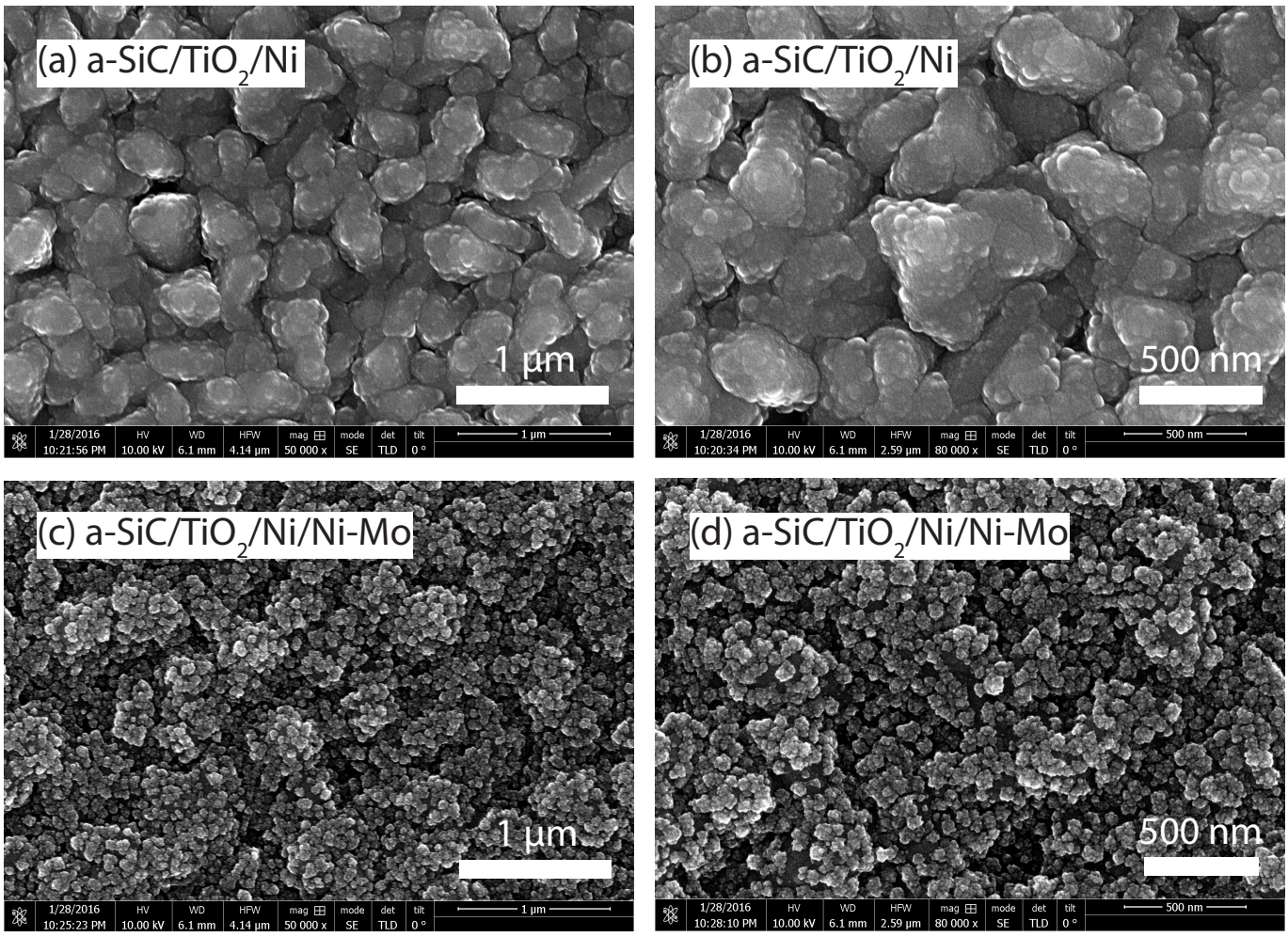

Fig. S15 SEM images of (a) a-SiC/TiO_2/Ni and (b) its magnification, (c) a-SiC/TiO_2/Ni/Ni–Mo and (d) its magnification.