**Supporting Information**

**Tailoring the Deposition of MoSe2 on TiO2 Nanorods Arrays via Radiofrequency Magnetron Sputtering for Enhanced Photoelectrochemical Water Splitting**

Yahia H. Ahmad 1, Fadi Z. Kamand 2, Atef Zekri 3, Kyu-Jung Chae 4,5, Brahim Aïssa 3,\* and

Siham Y. Al-Qaradawi 1,\*\*

1. Department of Chemistry and Earth Sciences, College of Arts and Sciences, Qatar University, Doha, P.O. Box 2713, Doha, Qatar.

2. Center for Advanced Materials, Qatar University, P.O. Box 2713, Doha, Qatar.

3. Qatar Environment & Energy Research Institute (QEERI), Hamad Bin Khalifa University (HBKU), Education City, P.O. Box 34110, Qatar Foundation, Doha, Qatar.

4. Department of Environmental Engineering, College of Ocean Science and Engineering, Korea Maritime and Ocean University, 727 Taejong-ro, Yeongdo-gu, Busan 49112, Republic of Korea

5. Interdisciplinary Major of Ocean Renewable Energy Engineering, Korea Maritime and Ocean University, 727 Taejong-ro, Yeongdo-gu, Busan 49112, Republic of Korea

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**Figure S1.** AFM image of MoSe2 sputtered on glass substrate for 90s. (a) Surface topography and (b) Thickness profile.

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**Figure S2**. TEM and HR TEM images of MoSe2/TiO2 NRs

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**Figure S3**. EDS mapping of MoSe2/TiO2 NRs

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**Figure S4**. High-resolution spectra of (a) Mo 3d and (b) Se 3d in pure MoSe2.



**Figure S5**. High-resolution spectrum of Ti 2p in TiO2 NRs.



**Figure S6**. Comparing the high-resolution spectrum of Ti 2p in TiO2 NRs and heterostructure.

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**Figure S7**. XRD spectra of FTO substrate and MoSe2/FTO.

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**Figure S8**. Uv-vis diffuse reflectance spectrum of FTO substrate.

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**Figure S9**. Tauc plots of TiO2 NRs and different heterostructures.

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**Figure S10**. Uv-vis diffuse reflectance spectrum and Tauc plot (inset) of MoSe2.



**Figure S11**. LSV voltammograms of different photocatalysts in 1.0 M KOH solution at dark.

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**Figure S12**. The equivalent circuit model used to simulate the experimental impedance data. Rs is the solution resistance, Cfilm is the film capacitance, Rfilm is the film resistance, Cdl is the double-layer capacitance, and Rct is the charge transfer resistance.

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**Figure S13**. The experimental impedance data vs. simulated values calculated by data fitting using the equivalent circuit model in Figure S11.

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**Figure S14**. The photoelectrochemical activity measurements of MoSe2. (a) LSV of MoSe2 in dark and light, (b) Experimental and data fitted impedance values at 0.5 V vs. Ag/AgCl, (c) the photocurrent response, and (d) Mott-Shottky plot.