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Nanostructured NiO/cubic SiC *p-n* Heterojunction Photoanode for Enhanced Solar Water Splitting

*Jingxin Jian,[a] Yuchen Shi,[a] Sebastian Ekeroth,[a] Julien Keraudy,[b] Mikael Syväjärvi,[a] Rositsa Yakimova,[a] Ulf Helmersson [a] and Jianwu Sun [a,]**

[a]*Department of Physics, Chemistry and Biology (IFM), Linköping University, SE-58183, Linköping, Sweden.*

[b]*Oerlikon Surface Solutions AG, Oerlikon Balzers, Iramali 18, LI-9496, Balzers, Liechtenstein*

[*]*E-mail: jianwu.sun@liu.se*

1. **Side-view SEM of the 3C-SiC samples with NiO deposition for 1, 4, 8 minutes**

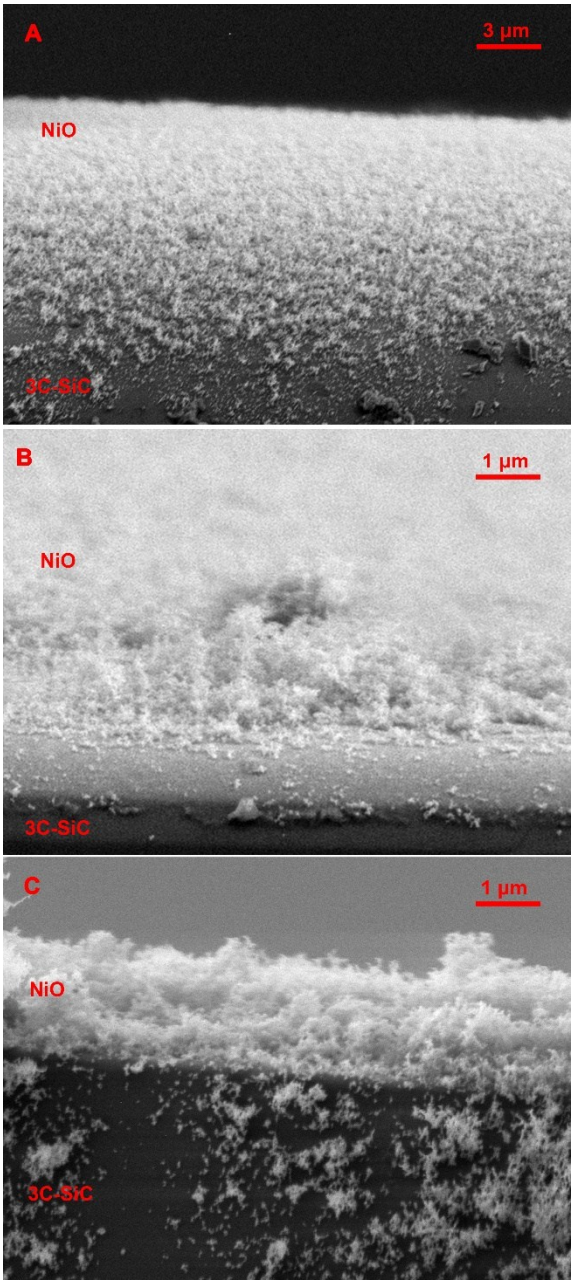

Figure S1. Side-view SEM images of 3C-SiC samples with NiO deposition for 1 min (A), 4 min (B) and 8 min (C).

2. SEM and EDXS spectrum of the bare 3C-SiC and 3C-SiC/NiO-4 min

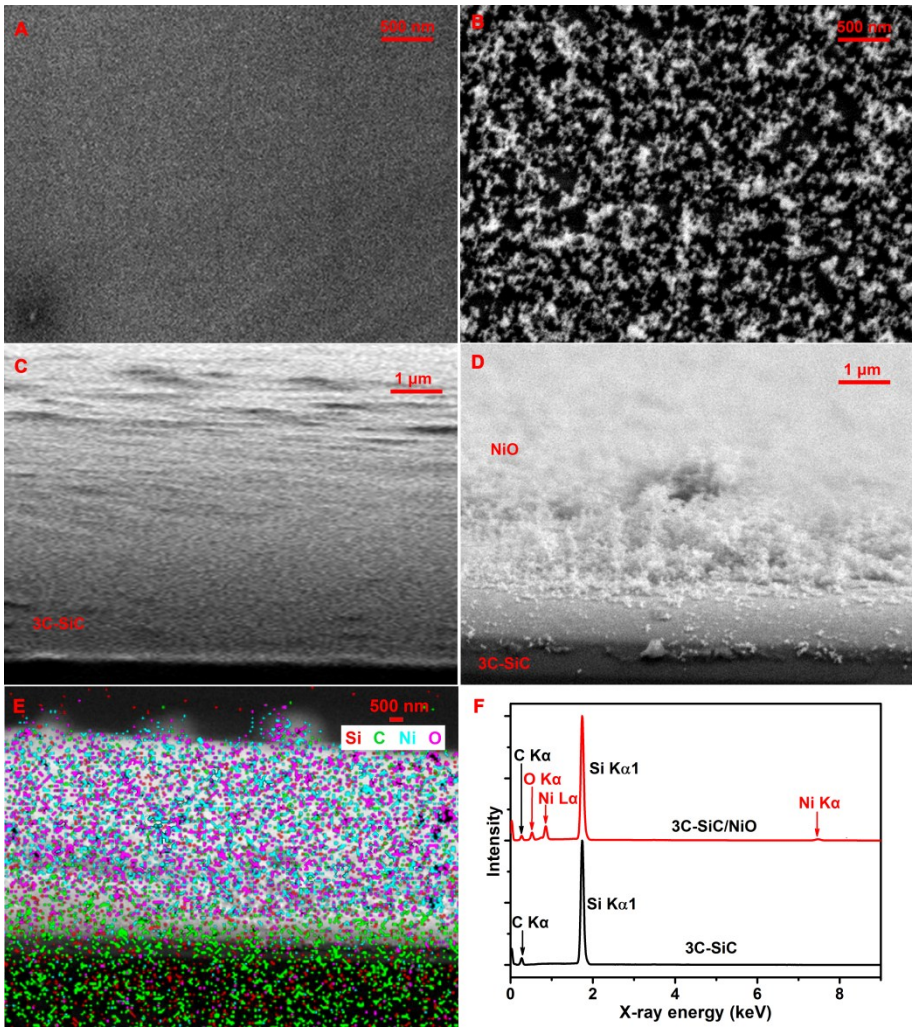

Figure S2. Top-view SEM images of 3C-SiC before (A) and after (B) NiO deposition for 4 minutes. Side-view SEM images of 3C-SiC before (C) and after (D) NiO deposition for 4 minutes. (E) Layered EDXS mapping image of Si, C, Ni and O elements from the side-view SEM image of the 3C-SiC with NiO deposition for 4 minutes. (F) EDXS spectra of 3C-SiC and the 3C-SiC with NiO deposition for 4 minutes, showing the K electron shell of C, O, Si, Ni elements and L electron shell of Ni element, respectively.

3. Current density-potential curves of the bare 3C-SiC and 3C-SiC with NiO deposition for 1, 4, 8 minutes.

The NiO nanoclusters were deposited on the 3C-SiC surface for 1, 4, 8 minutes, respectively. The 3C-SiC sample with NiO deposition for 4 minutes exhibited the highest photocurrent. With increasing the NiO deposition duration to 8 minutes, the photoanode shows a decreased photocurrent most probably due to reduced light transmittance through the nanostructured NiO.

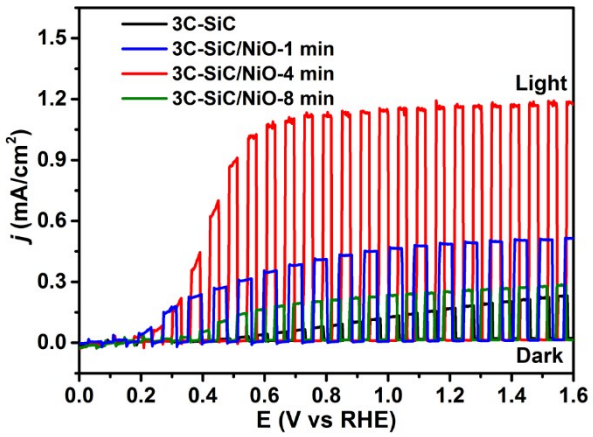

Figure S3. Current density-potential curves of the 3C-SiC and 3C-SiC/NiO phoanodes with NiO depostion for 1, 4, 8 minutes in 1.0 M NaOH under chopped AM1.5G 100 mW/cm^2 illumination, at the scan rate of 30 mV/s.

4. IPCE of the 3C-SiC/NiO photoelectrode.

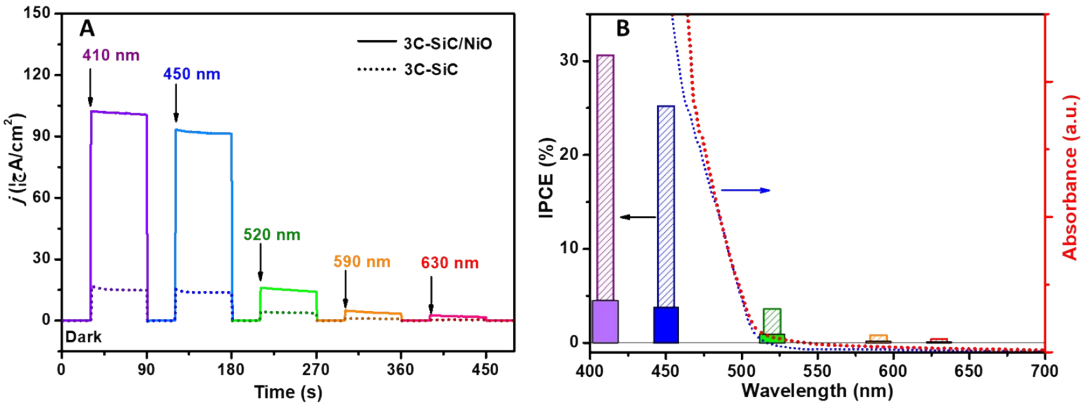

Figure S4. J-V curves (A) and the IPCE (B) of 3C-SiC/NiO-4min photoanode measured in 1.0 M NaOH solution at a bias of 1.0 V_{RHE}, with scan rate of 30 mV/s. The different wavelength LEDs (line width of ~10 nm) with a light power of 1 mW/cm^2 were used as light sources.

5. Photocurrent densities and Faradaic efficiencies of the 3C-SiC/NiO photoanodes.

The 3C-SiC sample with NiO deposition for 4 minutes exhibited the highest photocurrent. With increasing the NiO deposition duration to 8 minutes, the photoanode shows a decreased photocurrent most probably due to reduced light transmittance through the nanostructured NiO (see **Figure S3**). The 3C-SiC/NiO-4min photoanode exhibits a higher Faradaic efficiency (η_F) of ~80% for O_2 production than the bare 3C-SiC (50% η_F for O_2) at a bias of 1.0 V_{RHE}. With further increasing NiO thickness, the 3C-SiC/NiO-8min photoanode shows a highest O_2 evolution efficiency of 90% at 1.0 V_{RHE}. The Faradaic efficiencies for H_2 production are close to 100% for all three cases.

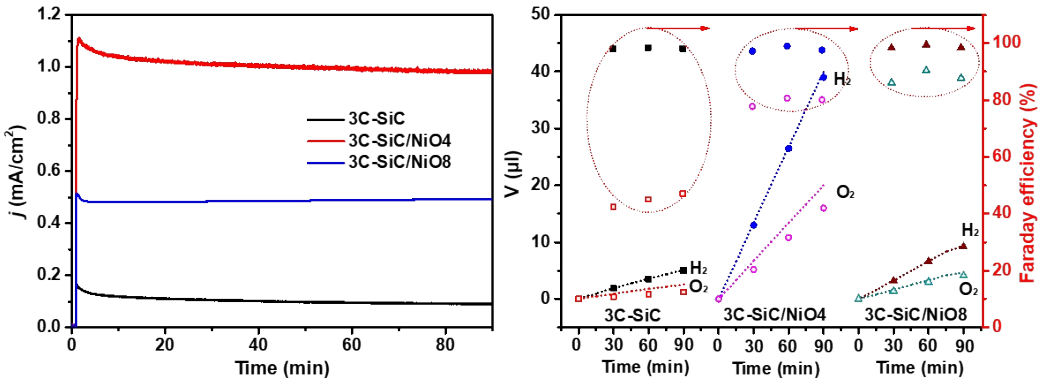

Figure S5. The photocurrent densities (A) and the H_2 and O_2 Faradaic efficiencies (B) of the 3C-SiC and 3C-SiC/NiO-4min, and 3C-SiC/NiO-8min photoanodes at 1.0 V_{RHE} under steady-state AM1.5G 100 mW/cm^2 illumination in 1.0 M NaOH solution. Faradaic efficiencies of the evolved H_2 and O_2 were obtained from gas chromatography measurement.

6. Mott-Schottky plots of 3C-SiC and 3C-SiC/NiO photoanodes.

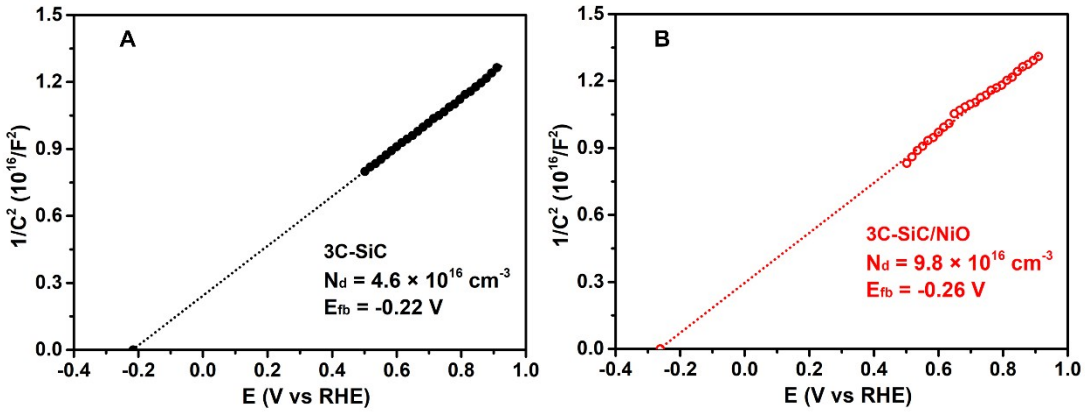

Figure S6. Mott-Schottky plots of 3C-SiC and 3C-SiC/NiO-4min photoanodes in 1.0 M NaOH solution. The flat-band potentials were obtained from the intercepts of the extrapolated lines and the doping concentrations were calculated from the slopes.

7. Bode phase plot of the 3C-SiC and 3C-SiC/NiO photoanodes.

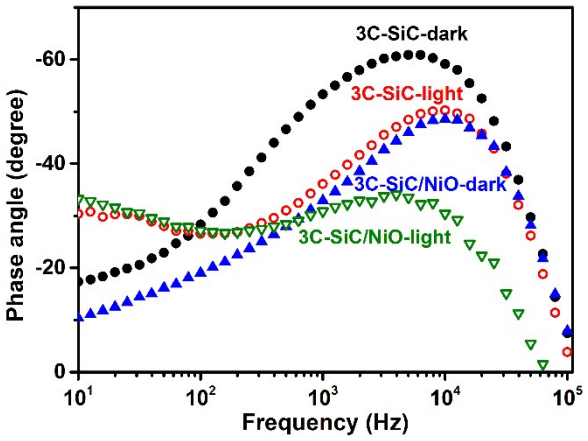

Figure S7. (A) Bode phase plots of 3C-SiC and 3C-SiC/NiO in the dark or under AM1.5G 100 mW/cm^2 illumination.

8. Table S1. Fitting data of EIS measurements for 3C-SiC and 3C-SiC/NiO in the dark or under light of AM1.5G 100 mW/cm² illumination.

	3C-SiC Dark	**3C-SiC/NiO Dark**	**3C-SiC Light**	**3C-SiC/NiO Light**
R_S (Ω cm^2)	12	12	12	12
R_{ct} (Ω cm^2)	1300	880	900	500
CPE_{SC}-T	3.4×10^{-6}	8×10^{-5}	3×10^{-5}	1×10^{-4}
CPE_{SC}-P	0.73	0.55	0.78	0.8
$R_{ct,\ trap}$ (Ω cm^2)	NA	NA	240	140
CPE_{trap}-T	NA	NA	3.6×10^{-6}	7×10^{-5}
CPE_{trap}-P	NA	NA	0.75	0.57