

## Supporting Information

Electrocatalytic activity of NiO on silicon nanowires with a carbon shell and its application to dye-sensitized solar cell counter electrodes

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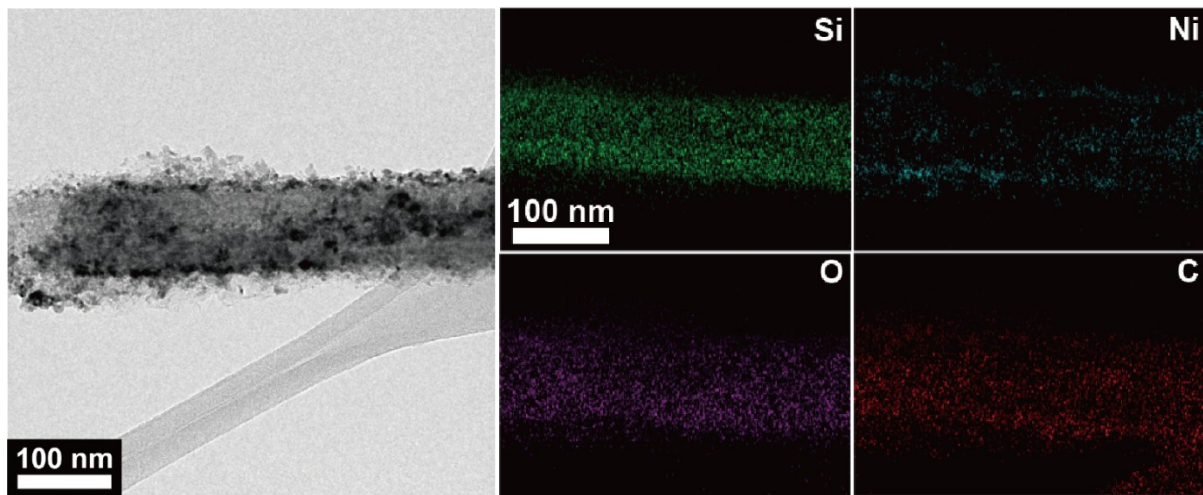
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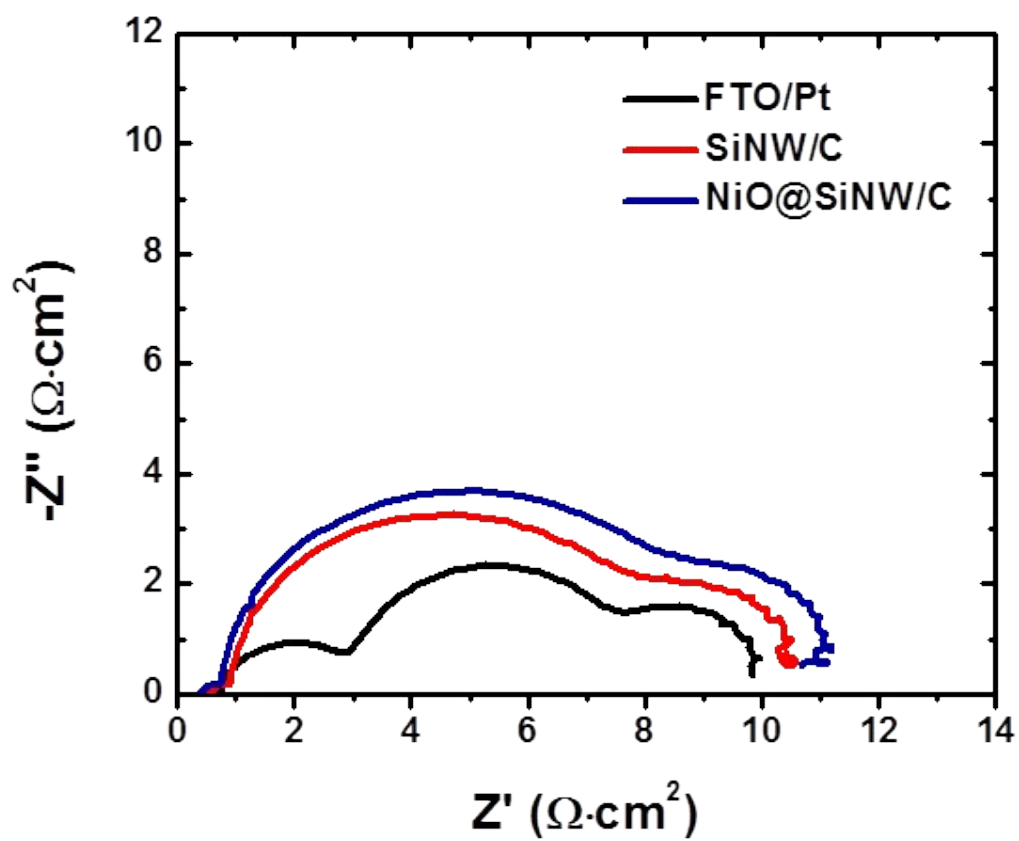
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## J-V curve scanning detail.

The JV scanning was performed at forward scanning direction, starting from 0.08 V to  $V_{oc}$ . The voltage step is 3 mV and interval time is 50 msec. Total points are around 250 depending on  $V_{oc}$ .



**Figure S1.** Transmission electron microscopy micrographs of a SiNW/C@NiO, and energy dispersive spectroscopy elemental mapping images of Si, Ni, O, and C.

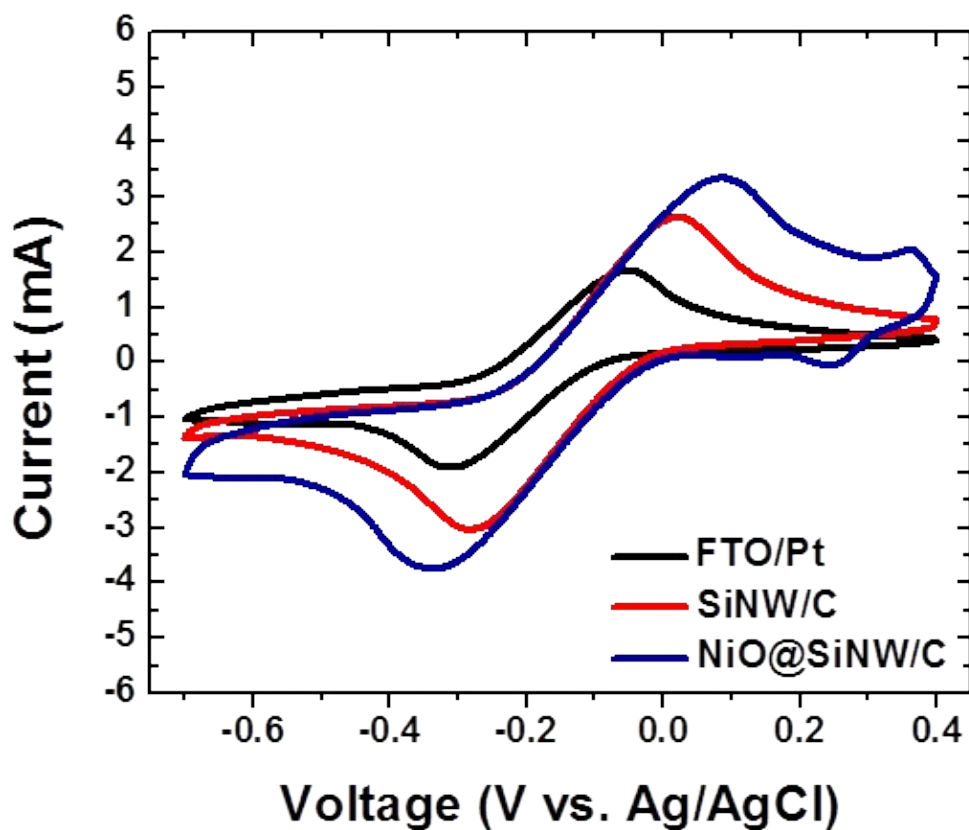


**Figure S2.** Electrochemical impedance spectroscopy for full dye-sensitized solar cells using Pt, SiNW/C, and NiO@SiNW/C as the counter electrodes.

**Table S1.** Photovoltaic parameters of dye-sensitized solar cells based on FTO/Pt, SiNW/C, and NiO@SiNW/C counter electrodes measured under AM1.5G illumination and electrochemical impedance spectroscopy parameters fitted from the equivalent circuit.

Counter Electrode	$V_{oc}$ [V]	$J_{sc}$ [mA/cm <sup>2</sup> ]	FF [%]	$\eta$ [%]	$R_s^{a)}$ [ $\Omega \cdot \text{cm}^2$ ]	$R_{ct}^{a)}$ [ $\Omega \cdot \text{cm}^2$ ]	$Z_n^{a)}$ [ $\Omega \cdot \text{cm}^2$ ]
FTO/Pt	0.762	16.55	68.4	8.62	0.60	0.46	0.27
SiNW/C	0.744	17.68	65.9	8.67	0.17	0.23	0.29
NiO@SiNW/C	0.759	18.52	67.5	9.49	0.19	0.07	0.25

<sup>a)</sup> Obtained from symmetric cells

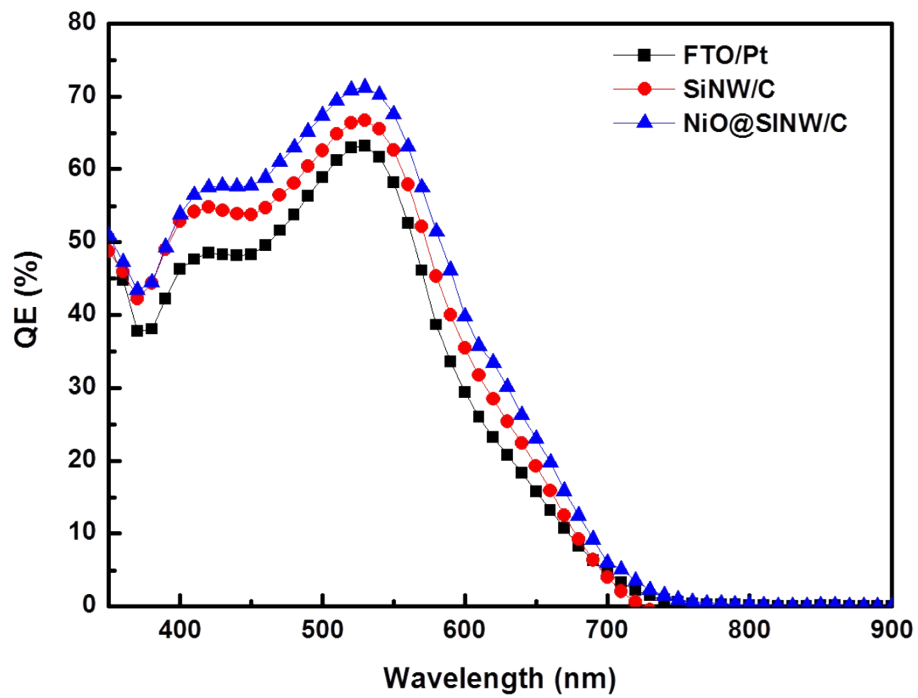


**Figure S3.** Cyclic voltammety curves of FTO/Pt, SiNW/C, and NiO@SiNW/C electrodes in  $5 \times 10^{-3}$  M  $K_3Fe(CN)_6$ / 0.1 M KCl solution at scan rate of  $50 \text{ mV s}^{-1}$ .

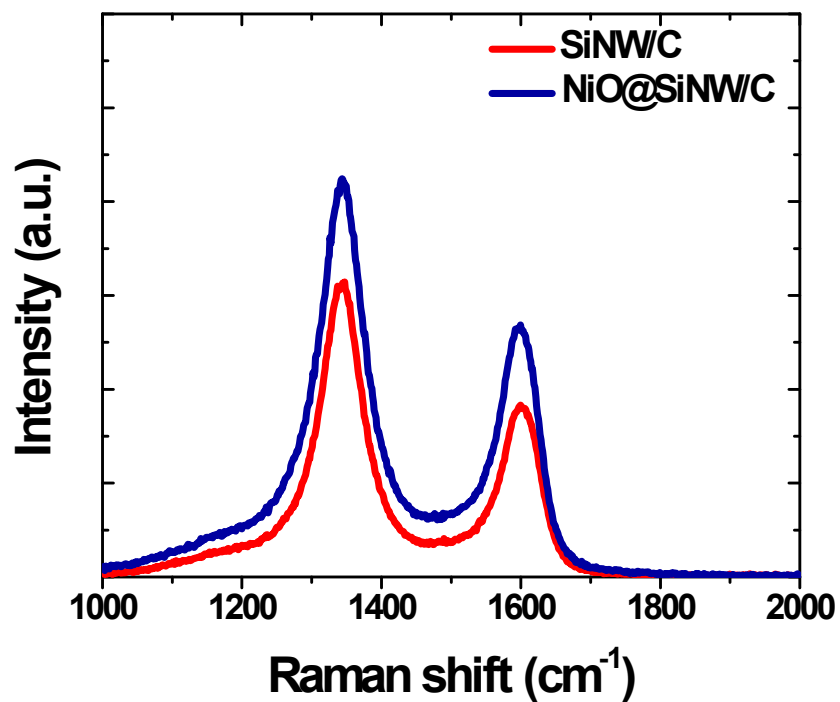
**Table S2.** Calculated electroactive surface area values of FTO/Pt, SiNW/C, and NiO@SiNW/C electrodes.

Counter Electrode	FTO/Pt	SiNW/C	NiO@SiNW/C
A ( $\text{cm}^2$ )	2.132	3.391	4.290

The tested area is  $1.0 \times 1.5 \text{ cm}^2$ .



**Figure S4.** The incident photon-to-current conversion efficiencies(IPCEs) spectra for FTO/Pt, SiNW/C, and NiO@SiNW/C electrodes.



**Figure S5.** Raman spectra for SiNW/C and NiO@SiNW/C.

**Table S2.** Peak positions of D and G bands and  $I_D/I_G$  ratios.

	D band ( $\text{cm}^{-1}$ )	G band ( $\text{cm}^{-1}$ )	$I_D/I_G$
NiO@SiNW/C	1343	1599	1.58
SiNW/C	1343	1599	1.71