

Supplementary Information

Several Highly Efficient Catalysts for Pt-free and FTO-free Counter Electrodes of Dye-Sensitized Solar Cells

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1. SEM image of the BG/CC/TiC CE.

To make sure the thickness of conductive carbon (CC) layer coated on the bare glass substrate, the SEM image of the Gl/CC/TiC CE is shown in Fig. S1. It shows clearly the cross-section of the CE with about 20 μm in width of the CC layer, and 7 μm in width of TiC layer.

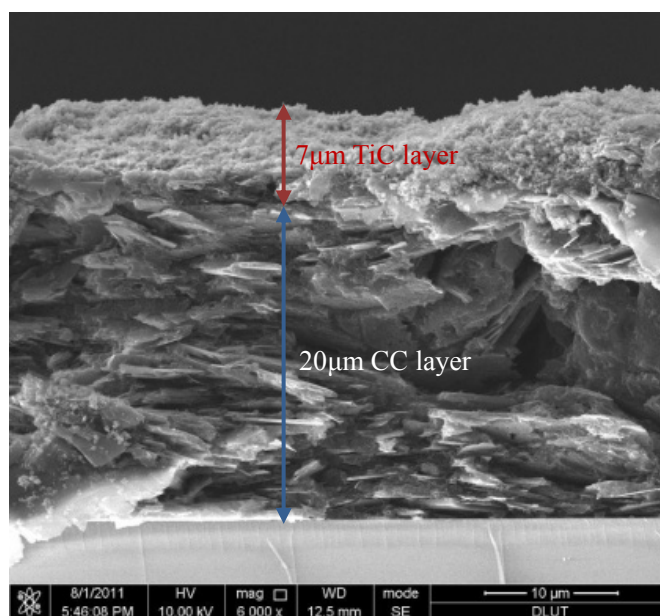


Fig. S1. SEM image of the BG/CC/TiC electrode (cross-section).

2. Electrochemical characterizations of the CEs using TiC, WO_2 , and VN deposited on FTO substrate by EIS measurements.

To confirm the electrochemical characteristics of the electrodes using TiC, WO_2 , and VN deposited on FTO substrate, EIS measurements were carried out in a symmetrical dummy cell fabricated with two identical electrodes. Fig. S2 shows the Nyquist plots of the dummy cells, and the corresponding parameters are listed in Table S1. According to the EIS parameters, the values for the series resistance (R_s) and charge transfer resistance (R_{ct}) of the three catalysts were all very small, indicating they are all highly effective in catalyzing the reduction of triiodide to iodide. The R_s and R_{ct} values of the FTO/ WO_2 CE are the largest among the three catalysts, generating a low fill factor (FF) and relatively low power conversion efficiency. As to the FTO/VN CE, the R_s and R_{ct} values are slightly larger than those of FTO/TiC CE, but the diffusion resistance (Z_N) value of FTO/VN CE is smaller, resulting in similar energy conversion efficiencies of FTO/TiC and FTO/VN CEs.

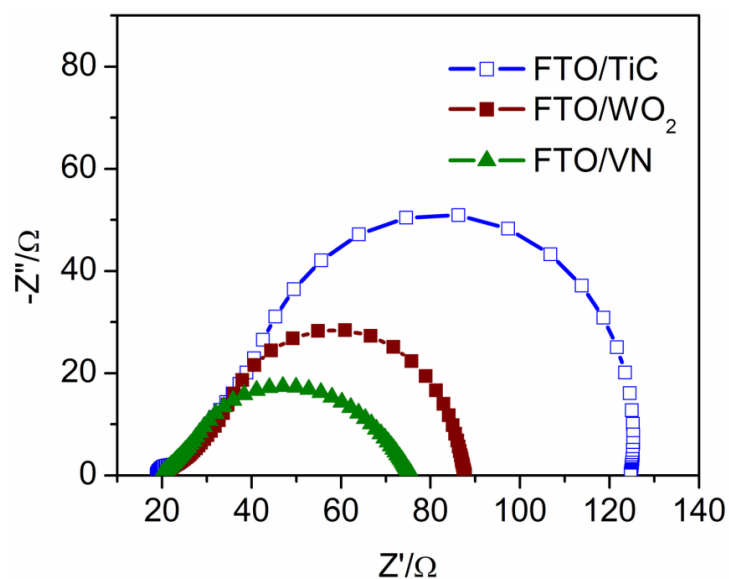


Fig. S2. Nyquist plots of the dummy cells fabricated with TiC, WO₂, and VN deposited on FTO substrate.

Table S1. EIS parameters of the dummy cells fabricated with TiC, WO₂, and VN deposited on FTO substrate.

CEs	R_s/Ω	R_{ct}/Ω	Z_N/Ω
FTO/TiC	18.84	4.30	101.6
FTO/WO ₂	20.80	6.25	60.72
FTO/VN	19.84	5.76	50.18