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Hybrid n-type $Sn_{1-x}Ta_xO_2$ nanowalls bonded with graphene-like layers as high performance electrocatalyst for flexible energy conversion device

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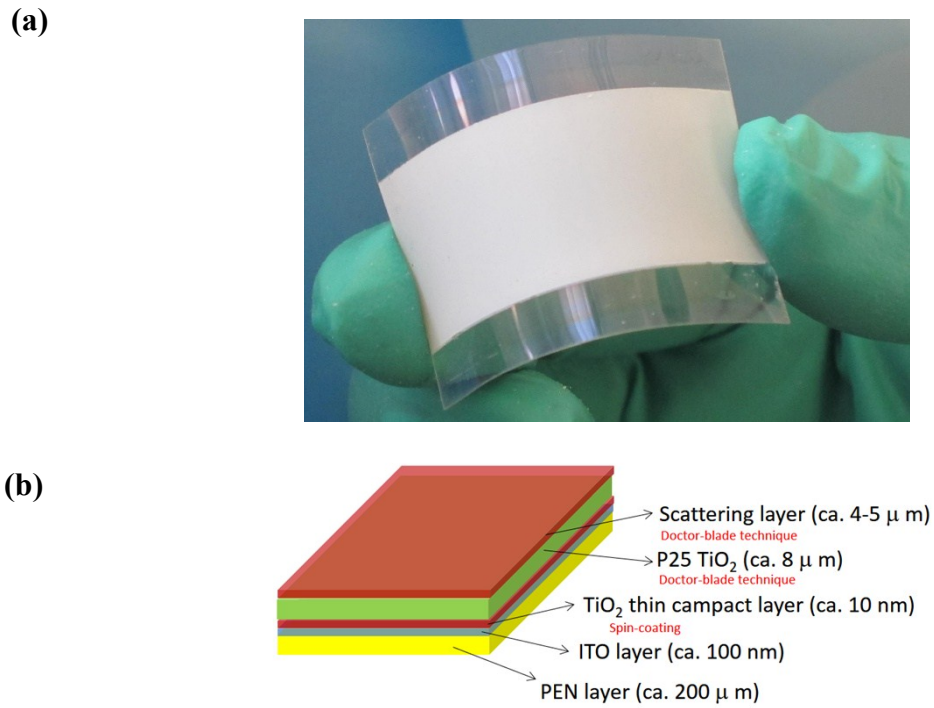

Fig. S1 (a) Digital photograph of plastic working electrode in this study; (b) Configuration of the cross-section for the working electrode. The numbers in brackets are thicknesses for every layer.

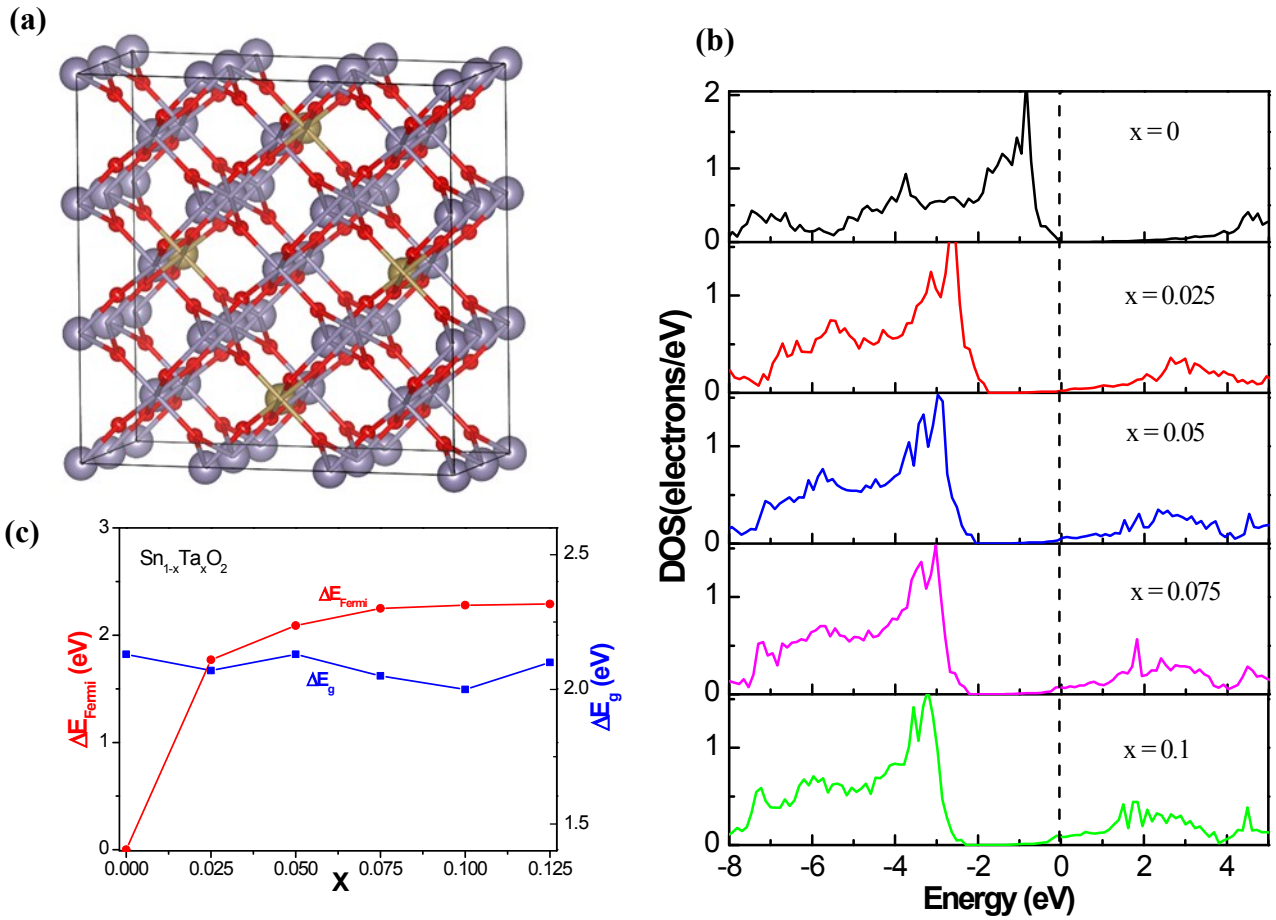

Fig. S2 (a) Configurations of $Sn_{0.9}Ta_{0.1}O_2$. Grey ball: Sn; green ball: Ta; red ball: O. (b) Total density of states for $Sn_{1-x}Ta_xO_2$ when x = 0, 0.025, 0.05, 0.075, and 0.1, respectively. The energy of the valence band maximum of intrinsic SnO_2 is set to 0. (c) Fermi level shift (red line) and band gap (blue line) as a function of the level of Sn substitution by Ta.

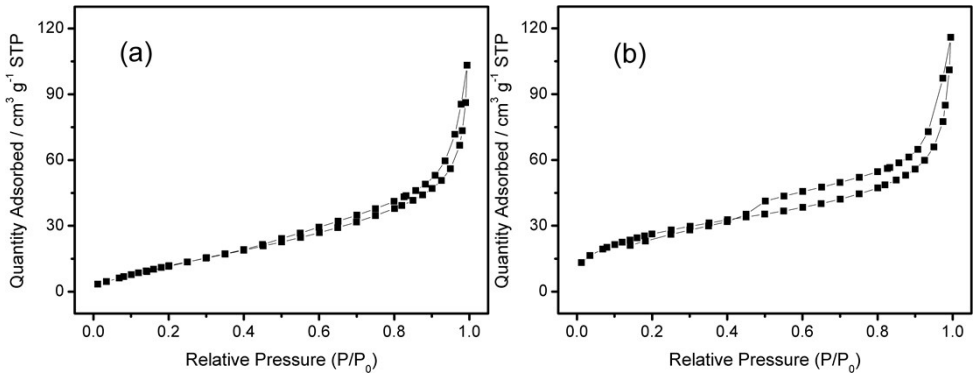

Fig. S3 N_2 adsorption-desorption isotherms of (a) $Sn_{0.925}Ta_{0.075}O_2$ and (b) $Sn_{0.925}Ta_{0.075}O_2$/C.

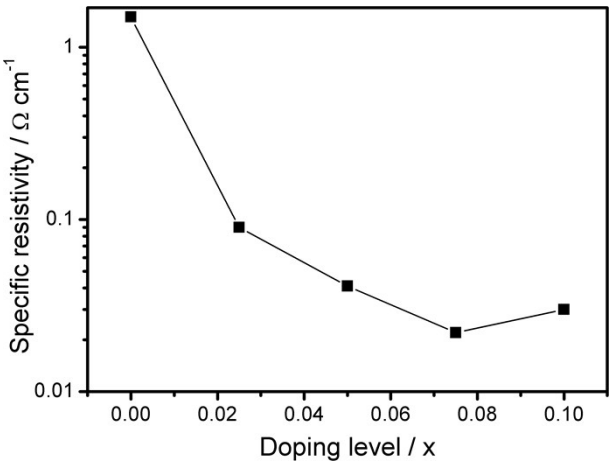

Fig. S4 Specific resistivity as a function of doping level for $Sn_{1-x}Ta_xO_2$ nanowall films.

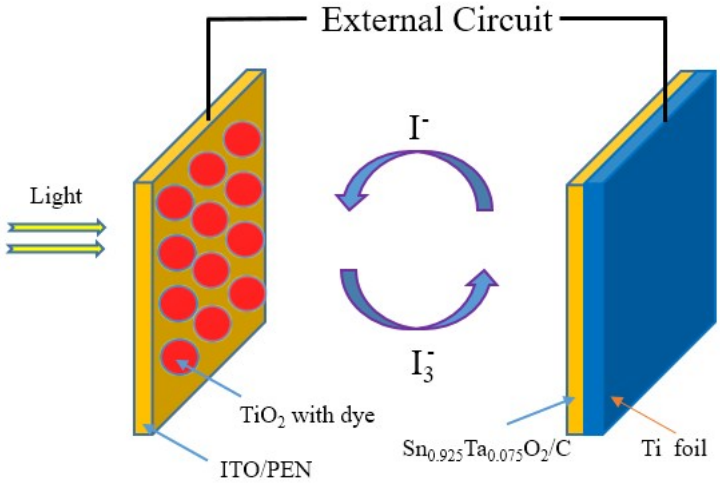

Fig. S5 Configuration of full flexible dye-sensitized solar cells in this study.

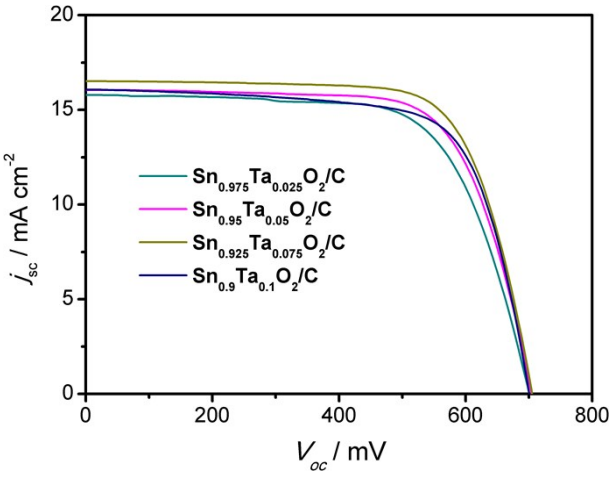

Fig. S6 *j-V* curves based on $Sn_{1-x}Ta_xO_2$/C hybrid structures.

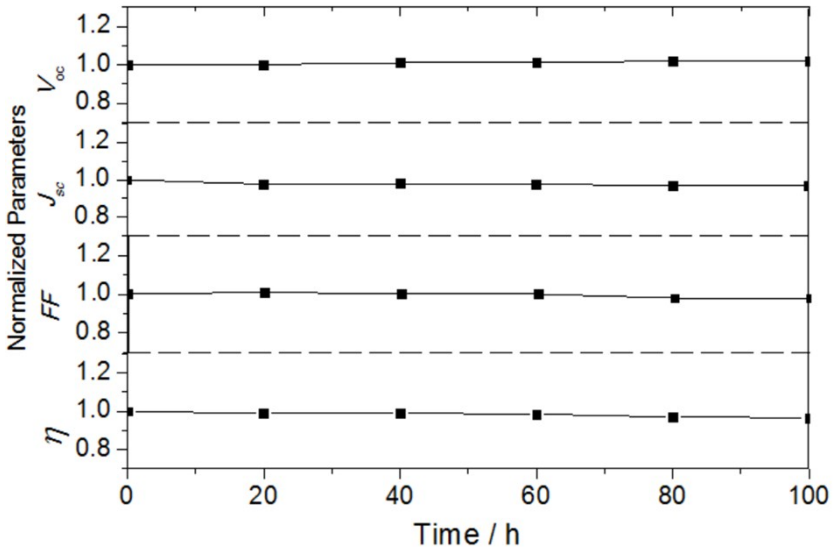

Fig. S7 The long-term stability of full flexible DSSCs assembled with $Sn_{0.925}Ta_{0.075}O_2$/C based electrode.

Table S1 Results of the impedance measurements.

samples	R_s	R_{ct} / Ω cm^{-2}	mF /cm^{-2}
Pt	7.2	2.0	0.14
SnO_2	20.2	8.2	1.66
SnO_2-C	11.5	3.6	2.10
$Sn_{0.975}Ta_{0.025}O_2$/C	10.3	2.8	2.27
$Sn_{0.95}Ta_{0.05}O_2$/C	10.0	2.6	2.43
$Sn_{0.925}Ta_{0.075}O_2$/C	9.0	2.1	2.36
$Sn_{0.9}Ta_{0.1}O_2$/C	11.3	2.8	2.23