Electronic Supplementary Information

Sputtering and sulfurization- combined synthesis of transparent WS_2 counter electrode and its application to dye-sensitized solar cells

Sajjad Hussain[a,b], ShoyebMohamad F. Shaikh[c,d], Dhanasekaran Vikraman[a,b], Rajaram S. Mane[c,e], Oh-Shim Joo[c,d], Mu. Naushad,[e] and Jongwan Jung[a,b,*]

[a]*Graphene Research Institute, Sejong University, Seoul 143-747, Republic of Korea*

[b]*Institute of Nano and Advanced Materials Engineering, Sejong University, Seoul 143-747, Republic of Korea*

[c]*Clean Energy Research Centre, Korea Institute of Science and Technology, Seoul, Republic of Korea*

[d]*School of Science, University of Science and Technology, 52 Eoeun dong, Yuseonggu, Daejeon 305-333, Republic of Korea*

[e]*Advanced Materials Research Chair, Department of Chemistry, College of Science, Bld-5, King Saud University, Riyadh, Saudi Arabia.*

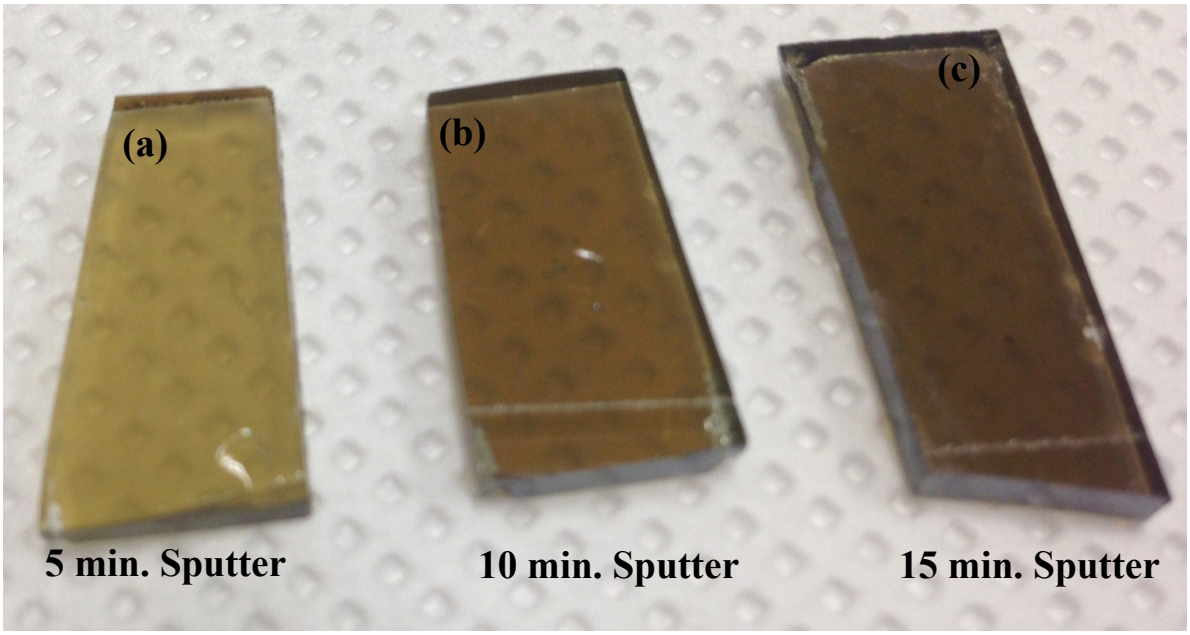

Fig. S1 3D photographical images for different sputtering time prepared WS_2 films (a) 5, (b) 10 and (c) 15 minutes

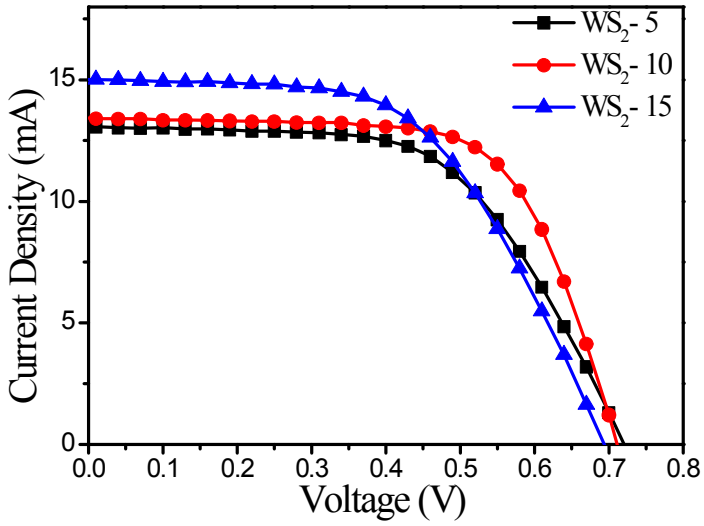

Fig.S2 J-V characteristics plot for different sputtering time prepared WS_2 films as a counter electrode

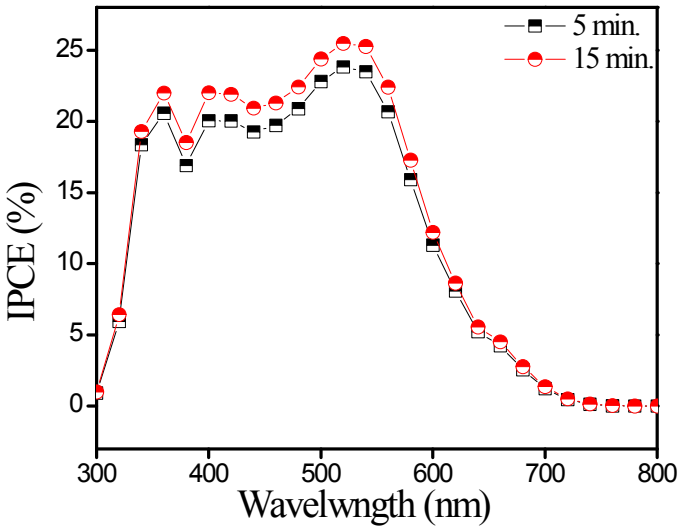

Fig. S3. IPCE measurement of different WS_2 CEs prepared at different sputtering time.

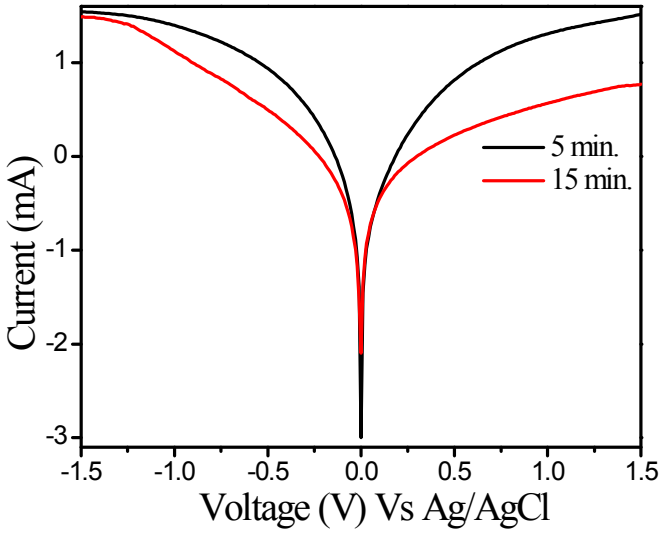

Fig. S4. Tafel polarization curves of symmetrical cells obtained using WS_2 CEs prepared at different sputtering time.

Table-S1 DSSC cell parameter values for different combination of counter electrode

Sr. No	DSSCs type	J_{sc}	V_{oc}	FF	η
1	**TiO_2-Pt**	**16.50**	**0.66**	**0.61**	**6.8**
2	TiO_2-5 Min WS_2	13.07	0.72	0.58	5.4
3	**TiO_2-10 Min WS_2**	**13.43**	**0.71**	**0.66**	**6.3**
4	TiO2-15 Min WS2	15.01	0.69	0.55	5.8