Supporting Information for

Photocapacitor integrating voltage-adjustable hybrid supercapacitor and silicon solar cell generating a Joule efficiency of 86% †

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† Electronic supplementary information (ESI) available. See DOI: 10.1039/xxxxxx

Figures S1~S7

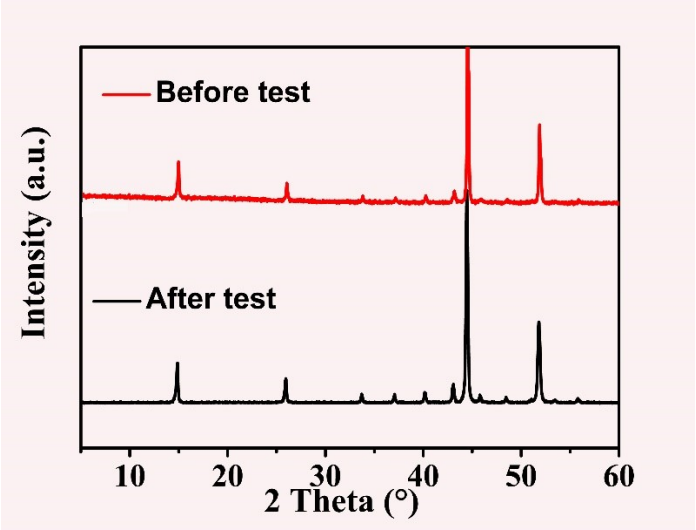

Fig. S1. The XRD pattern of $Ni(HCO_3)_2$@Ni before and after electrochemical test.

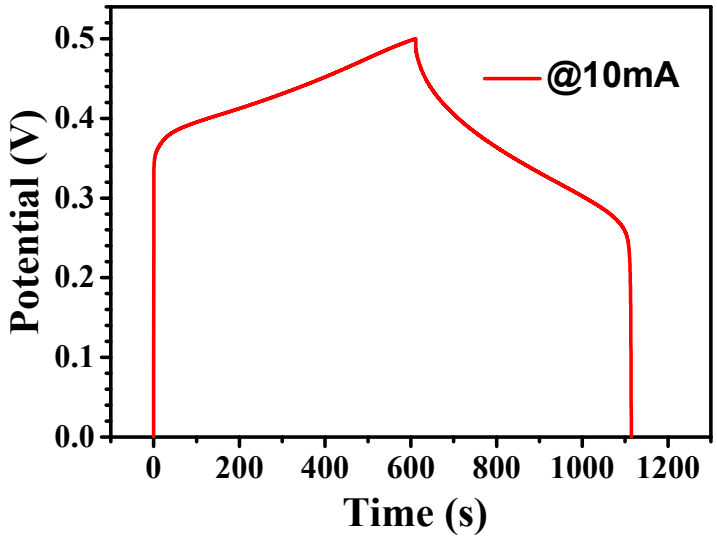

Fig. S2. The GCD curve of the $Ni(HCO_3)_2$@Ni electrode at charge/discharge current of 10 mA.

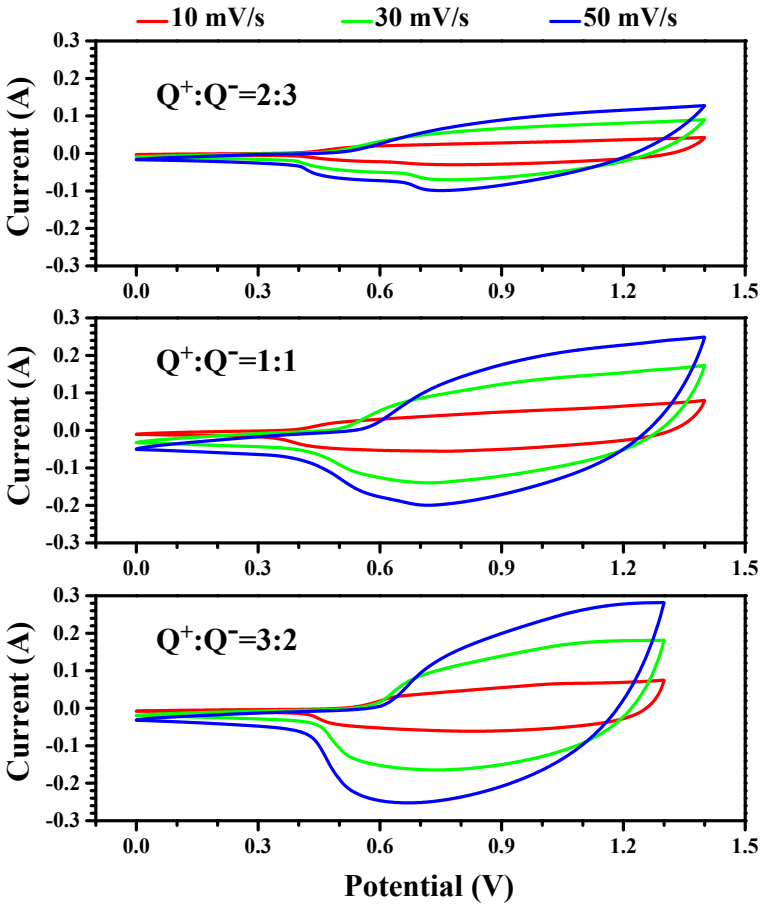

Fig. S3. CV curves of the VAHSCs with different scan rates and intrinsic capacity ratios.

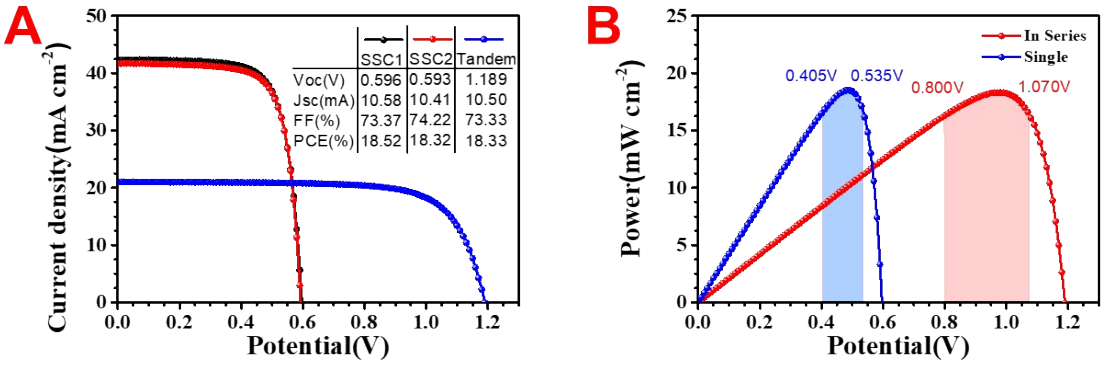

Fig. S4. A, J-V curves and **B**, P-V curves of single Si wafer and the two Si wafers in series.

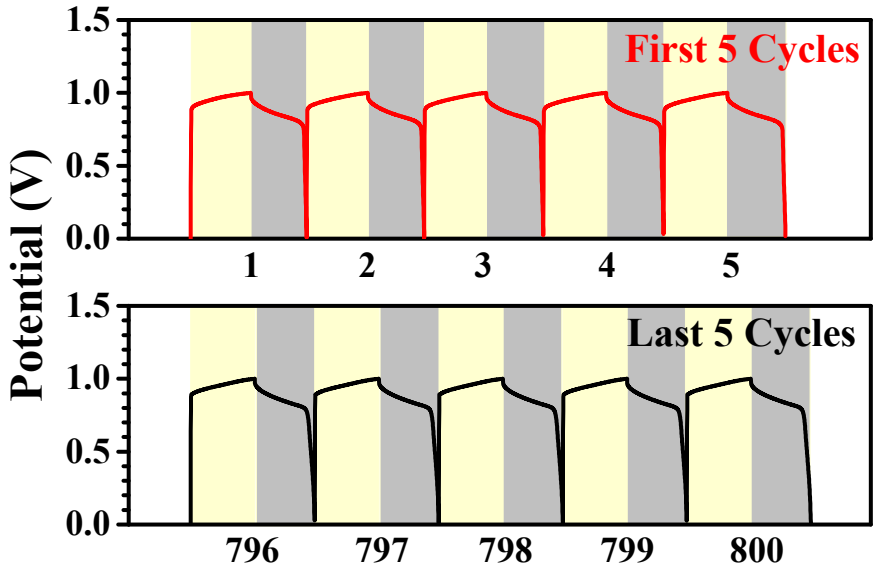

Fig. S5. Charge/discharge cycle stability test of IPCs at the first five cycles and the last five cycles.

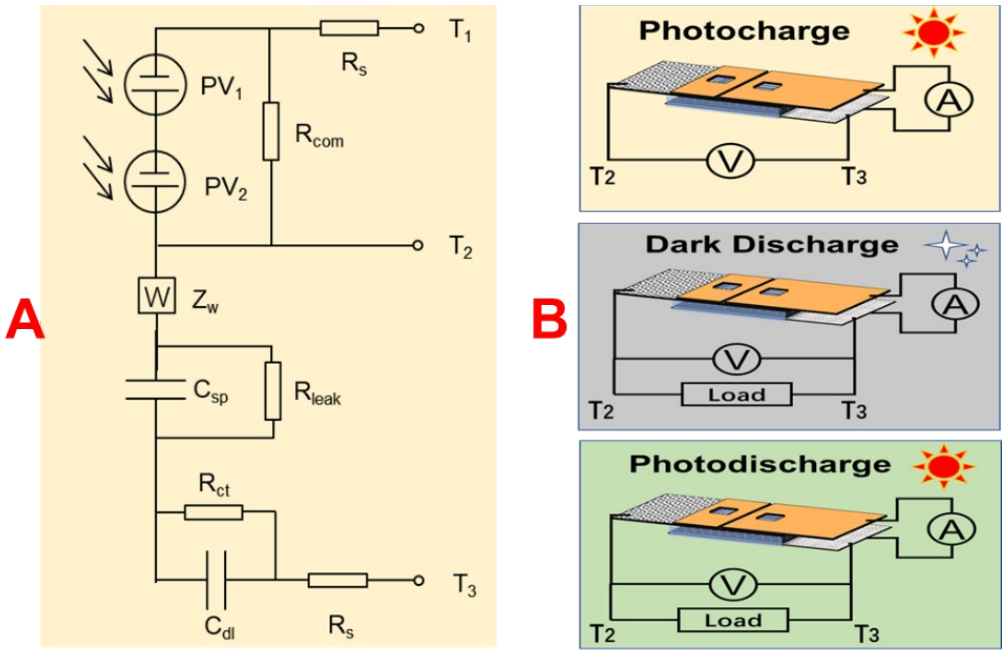

Fig. S6. A, The equivalent circuit of the IPC. **B**, The schematic diagram of IPC's charging/discharging performance measurement.

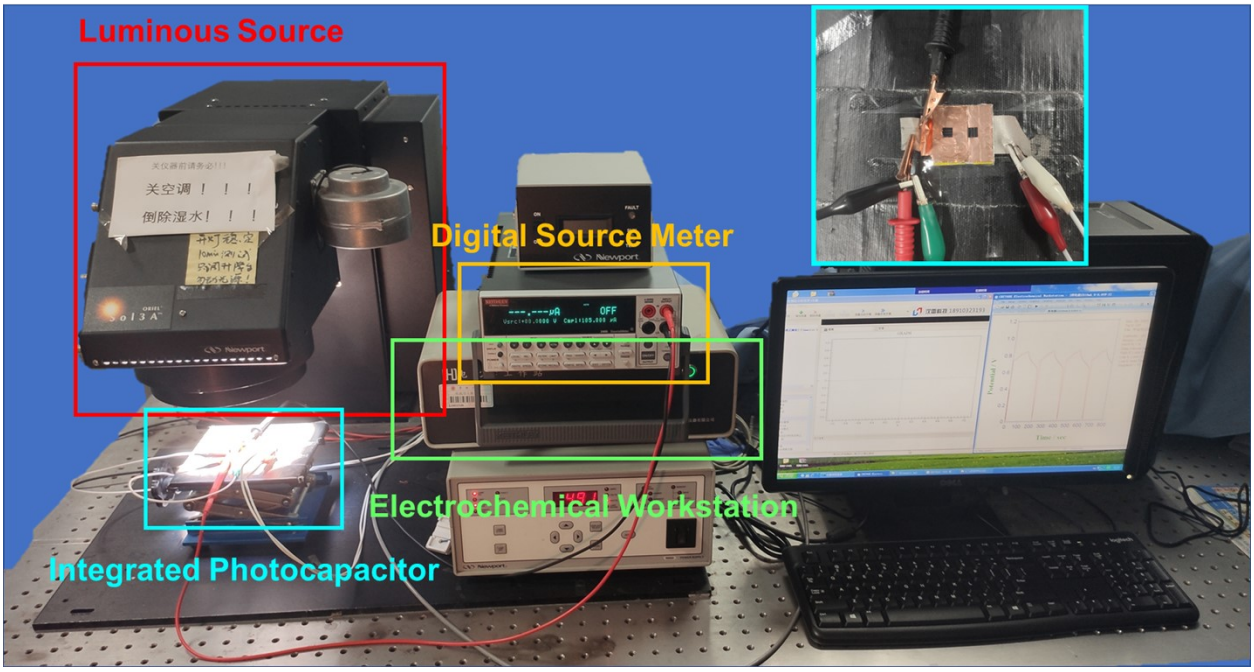

Fig. S7. The digital photo of the IPC under photocharging.

Tables S1~S4

Table S1. Photoelectric parameters of important solar harvest and storage integrators (SHSIs).

PV unit	$\eta_{L\text{-}E}$(%)	V_{OC}(V)	Storage unit	$\eta_{E\text{-}C}$(%)	Window(V)	η_{CS}(%)	$\eta_{overall}$(%)	Year	Ref
DSSC	6.1	0.75	SSC	84	0.72		5.12	2013	10
PSC	13.6	0.974	ASC		0.8	10		2015	11
PSC	12.65	0.96	LIB		1.0~2.6		7.8	2015	12
Si-OSC	13.39	0.59	ASC				10.5	2017	13
PSC	16.10	1.06	Solid ASC	80.3	0.91	10.97		2017	14
PSC	14.40	0.96	LIB	77.2	3.0		9.36	2017	15
Ino-PSC	6.1	1.22	Si-gel-SC		1.2	5.1		2018	16
PSC	14.01	1.05	LIC		3.0		8.41	2019	17
PSC	10.96	1.09	LIB		3.14		7.3	2020	18
PSC-OSC	17.16	1.64	Solid ASC	72.4	1.6	12.43		2020	19
PSC	22.44	1.18	ASC	90.0	1.1	20.53	18.34	2022	22
Si	18.33	1.19	VAHSC	98.3	1.0	18.01	15.49	2022	Our work

Table S2. Resistance values of $Ni(HCO_3)_2$@Ni electrodes synthesized with different times.

Electrode (synthesized time)	R_s (Ω)	R_{CT} (Ω)
3h	0.97	5.82
4h	0.73	7.63
5h	0.71	12.27
6h	1.01	20.72

Table S3 Capacity, energy and efficiency of device with different Q^+_i/Q^-_i in charge/discharge.

Q^+_i/Q^-_i	Charged Q_C (C)	Discharged Q_C (C)	Charged E （mWs）	Discharged E （mWs）	$\eta_{Coulomb}$ （%）	η_{Joule} （%）
3/2	3.6194	3.5201	3680.46	2916.54	97.25	79.24
1/1	5.7155	5.6001	5779.50	4305.06	97.98	74.49
2/3	5.8167	5.3247	5148.27	3983.88	91.54	77.38
2/3 (PC)	6.2955	5.5474	6216.88	4700.61	88.12	75.61

Q^+_i and Q^-_i are the intrinsic capacity of anode and cathode, respectively. Q_C is the circulating capacity in charging/discharging, E is energy, PC is pre-charge.

Table S4 The efficiency and energy loss ratio of the photocapacitor under different V_{work}.

V_{work} (V)	η_{PV} （%）	$\eta_{storage}$ （%）	Storage loss （%）	η_{Joule} （%）	Joule loss （%）	$\eta_{overall}$ （%）
0.80	18.33	84.03	15.97	80.89	19.11	12.46
0.85	18.33	89.88	10.12	80.28	19.72	13.22
0.90	18.33	94.76	5.24	80.11	19.89	13.91
0.95	18.33	97.18	2.82	83.75	16.25	14.92
1.00	18.33	98.28	1.72	86.01	13.99	15.49