Electronic Supplementary Material (ESI) for Sustainable Energy & Fuels.

Core-shell structure of cobalt sulfide//G-Ink towards high energy density of asymmetric hybrid supercapacitor

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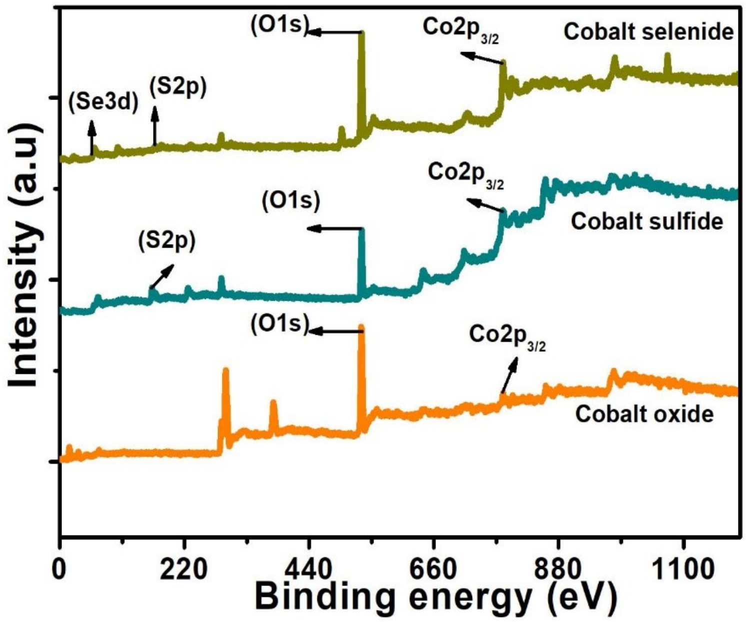

Fig. S1. XPS survey spectrum for cobalt oxide, cobalt sulfide and cobalt selenide samples.

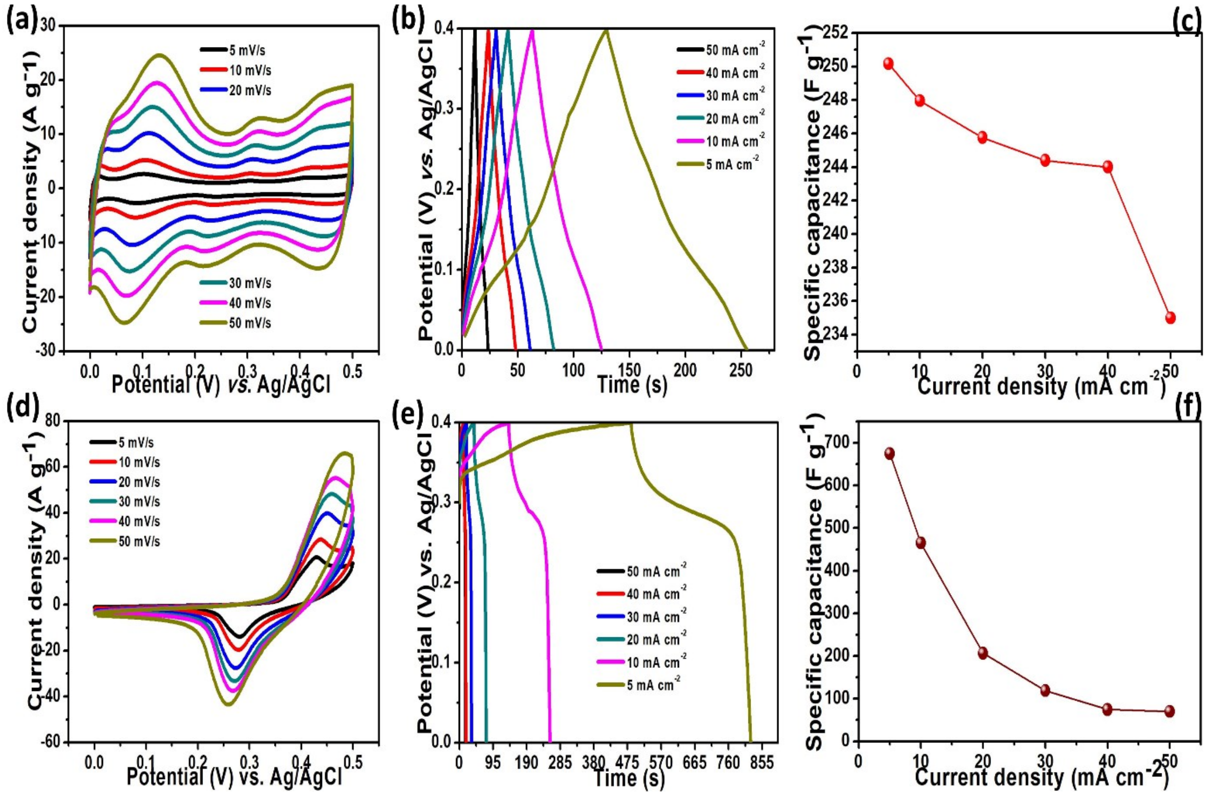

Fig. S2. (a-c) cobalt oxide curves of CV, GCD, and current density vs specific capacitance, (d-f) cobalt selenide curves of CV, GCD, and current density vs specific capacitance.

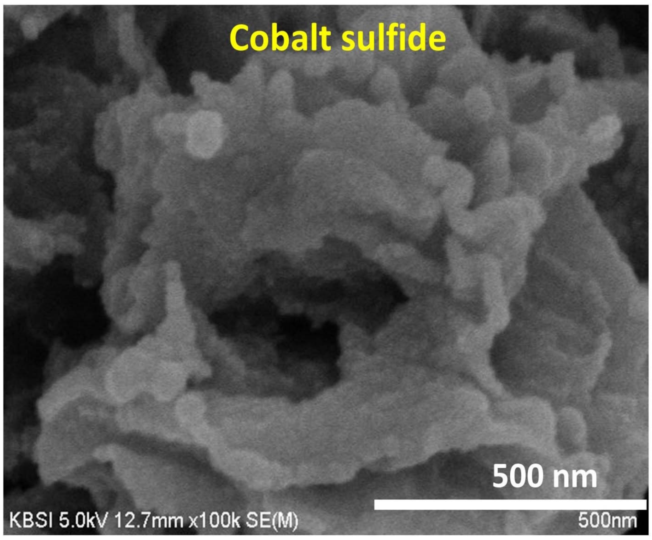

Fig. S3. FE-SEM image of cobalt sulfide after long-term stability of 3000 cycles.

Table S1. Specific capacity of cobalt sulfide core-shell nanostructure comparison with recent reports.

Electrode	Method	Specific capacity (mAh g^{-1})	Electrolyte	ref
Cobalt sulfide	**CBD**	**449.74**	**2 M KOH**	**This work**
$Sn_{0.33}Ni_{0.67}Se_2$	Hydrothermal	346	3 M KOH	[1]
Cu-Co_9S_8 NTAs	Hydrothermal	366	6 M KOH	[2]
Co_9S_8/MnS@N-C@MoS_2	Hydrothermal	306	2 M KOH	[3]
Co_9S_8@$Ni(OH)_2$	CBD+ED	149.4	6 M KOH	[4]
CNTs@Ni–Co–S	CVD+Electrodeposition	222.0	2 M KOH	[5]
$CuCo_2O_4$	Hydrothermal	345	3 M KOH	[6]
Ni_3S_2/$Ni_{12}P_5$/NF	Hydrothermal	85	3 M KOH	[7]
$Ni_{0.33}Co_{0.67}Te$	Hydrothermal	131.2	6 M KOH	[8]
Bi_2O_3/Bi_2Se_3	Solvothermal	113.8	2 M KOH	[9]
$NiMoO_4$	Electrospinning	214	6 M KOH	[10]
ANM-NiS-rGO	Hydrothermal	150	3 M KOH	[11]
$CuCo_2S_4$@$Co(OH)_2$	Hydrothermal	258	6 M KOH	[12]
$FeCo_2S_4$/CMF	Hydrothermal	337.5	3 M KOH	[13]
CoO/Co-Cu-S	Hydrothermal	320	6 M KOH	[14]
CP-M-LDH-CH	Electrodeposition	164	6 M KOH	[15]
$Ni_2P_2O_7$/NiCo-OH	Hydrothermal	281	2 M KOH	[16]
$CuCo_2S$	Hydrothermal	166.67	6 M KOH	[17]
(Ni,Co)Se_2/NiCo LDH	Hydrothermal+Electrodeposition	174	3 M KOH	[18]
Zn–Co–S	Hydrothermal	366.7	6 M KOH	[19]
$FeCo_2S_4$	Hydrothermal	337	3 M KOH	[20]
CNTs@C@Cu_{2x}Se	Solvothermal	399	6 MKOH	[21]
WS_2/$Ni(OH)_2$	Electrospinning+Hydrothermal	354	2 M KOH	[22]

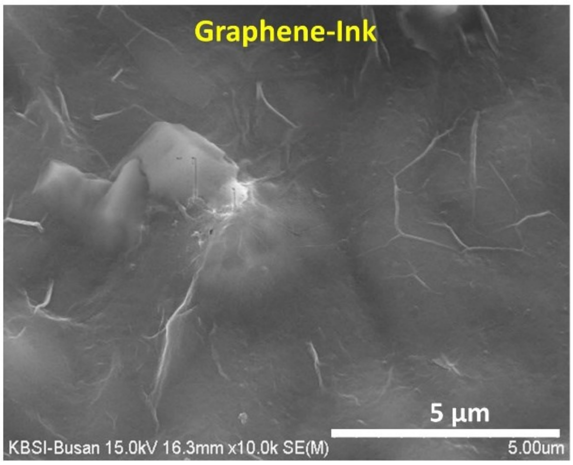

Fig. S4. FE-SEM image of Graphene-Ink

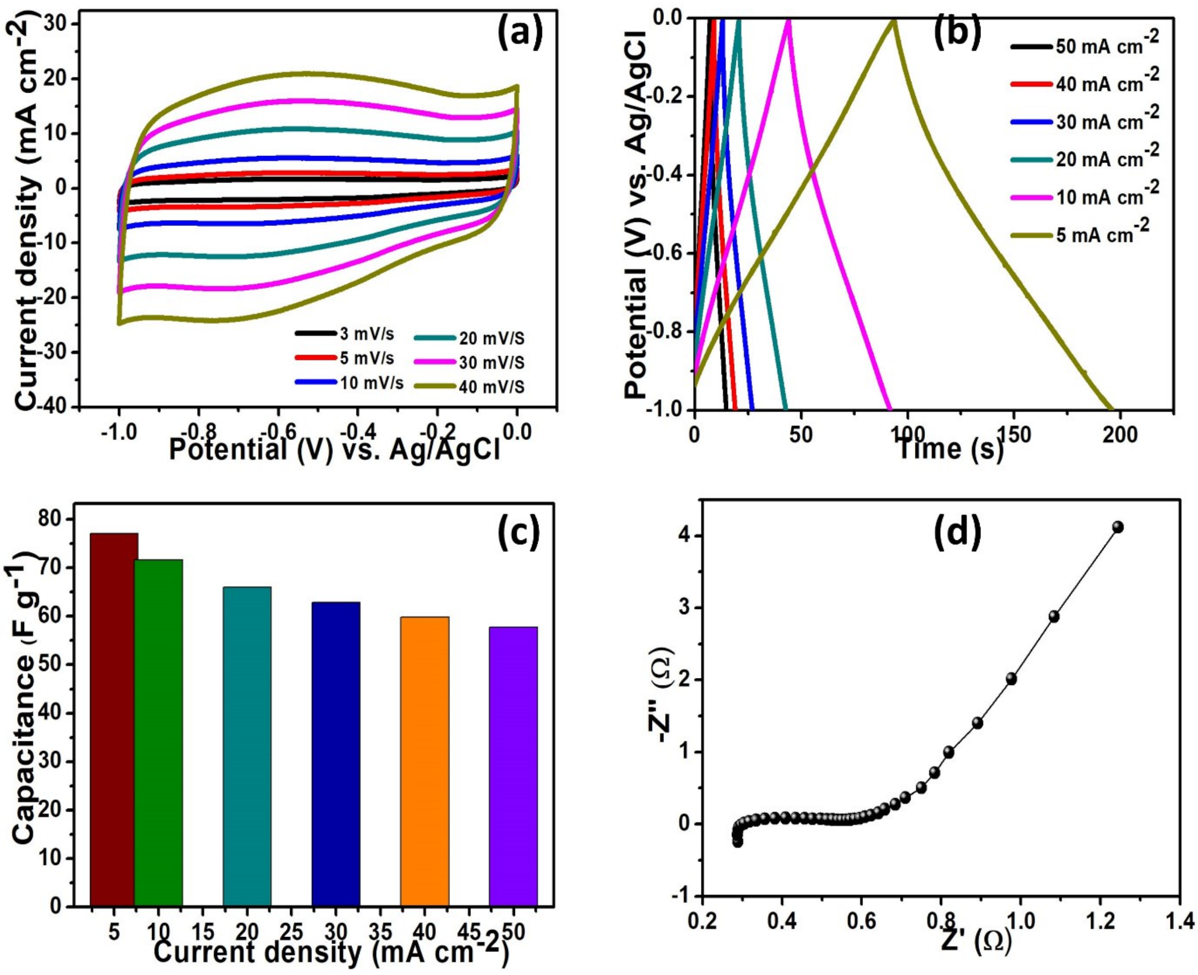

Fig. S5. (a-d) Graphene-Ink curves of CV , GCD, EIS and specific capacitance vs current density in a 2 M KOH electrolyte solution.

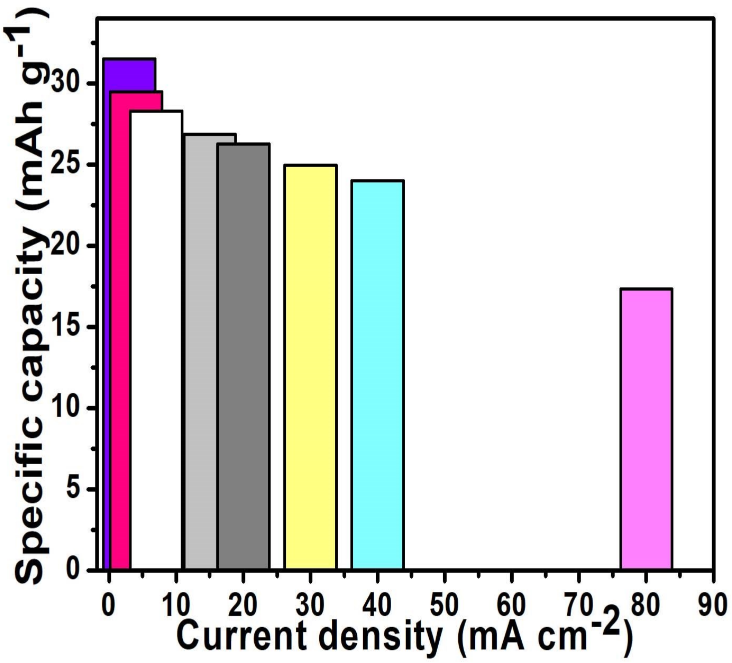

Fig. S6. Specific capacity vs current density of hybrid supercapacitor at various current densities.

Table S2. Energy and power density comparison of hybrid supercapacitor device with previous reports.

Electrode	Ed (Wh kg^{-1})	Pd (W kg^{-1})	Ref
Cobalt sulfide	**35.43, 19.51**	**612.38, 14304.68**	**This work**
Mo–Co S/CC//PVA/KOH//AC/CC	14.68	369	[23]
Ni@rGO-Co_9S_8//Ni@rGO-Ni_3S_2	31.4	252.8	[24]
P-$MnCo_2S_4$//AC	20.8	400	[25]
Co_9S_8@$Ni(OH)_2$//AC	31.35	252.8	[4]
NiCo2O4//FeSe2	22.4	163	[26]
a-Co(OH)2/Co3O4//AC	22.4	290	[27]
$NiCo_2S_4$@PPy-50//AC	34.62	120.19	[28]
NiCo2S4//C	22.8	160	[29]
AB-NiCo2S4//AC	24.7	428	[30]
$CoNi_2S_4$//AC	33.9	409	[31]
$NiCo_2S_4$@NiO//AC	30.385	288	[32]
Ni_3S_2@CoS//AC	28.24	134.46	[33]
Co_3O_4/CoS/$Ni(OH)_2$@Co//AC	25.4	81.8	[34]
$Co(OH)_2$NAs//CNTs	19.1	112.5	[35]

AC//CFS-10/NF	19.8	249.4	36
CuS–CNTs@NF//AC	22.14	15.52	37

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