Doping-driven electronic structure and conductivity modification of nickel sulfide

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1. Relationship between real impedance and $\omega^{-1/2}$ of NS, CoNS, MnNS and AgNS Electrode in the low-frequency region is liner fitted.

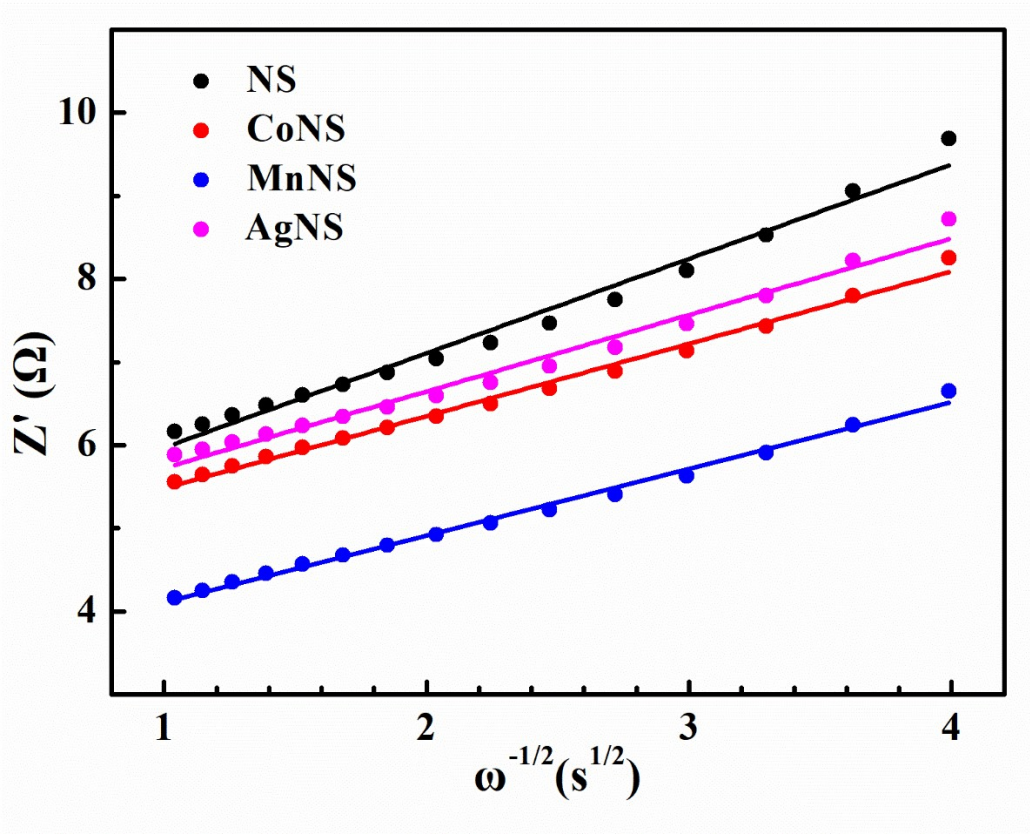

Fig. S1 Relationship between real impedance and reciprocal square root of lower angular frequencies

2. Dopant concentration in synthesized samples are detected by ICP-AES.

Table S1 Doped samples composition from ICP-AES

Sample	2% CoNS		0.5% MnNS		0.5% AgNS	
Element	Ni	Co	Ni	Mn	Ni	Ag
Mass fraction(%)	40.88%	1.02%	26.14%	0.09%	23.12%	0.23%

Atomic ratio of transition metals: Ni(%)	2.48%	0.36%	0.54%

3.Ni 2P binding energy of fitted peaks is shown below.

Table S2 Ni 2P binding energy of fitted peaks

Sample	Ni $2P_{3/2}$			Ni $2P_{1/2}$		
	Ni^{2+}	Ni^{3+}	Sat.	Ni^{2+}	Ni^{3+}	Sat.
NS	853.43 eV	856.60 eV	860.85 eV	870.49 eV	874.30 eV	879.33 eV
2% CoNS	853.86 eV	856.51 eV	860.61 eV	871.46 eV	874.66 eV	879.24 eV
0.5% MnNS	854.19 eV	856.45 eV	860.51 eV	871.62 eV	874.87 eV	879.58 eV
0.5% AgNS	853.98 eV	856.12 eV	860.53 eV	871.54 eV	874.70 eV	879.32 eV

4.The parameters of model in the equivalent circuit are simulated and listed in Table S3.

Table S3 Kinetic Parameters of NS, CoNS, MnNS and AgNS Electrode

Sample	R_s	R	R_{ct}	σ_w	D_{K^+}
NS	0.12 Ω	0.18 Ω	4.93 Ω	1.14 Ω $s^{-0.5}$	2.77×10^{-12} $cm^2\cdot s^{-1}$
2% CoNS	0.11 Ω	0.16 Ω	4.45 Ω	0.87 Ω $s^{-0.5}$	4.72×10^{-12} $cm^2\cdot s^{-1}$
0.5% MnNS	0.10 Ω	0.18 Ω	3.19 Ω	0.80 Ω $s^{-0.5}$	5.56×10^{-12} $cm^2\cdot s^{-1}$
0.5% AgNS	0.12 Ω	0.22 Ω	4.79 Ω	0.92 Ω $s^{-0.5}$	4.21×10^{-12} $cm^2\cdot s^{-1}$

5.Comparison of specific capacitance in this work and other previous reports.

Table S4 Comparison of specific capacitance with similar nickel sulfides

Samples	Specific capacitance	Current density	Electrolyte
PN-rGO/NCS[1]	1687 F g^{-1}	0.5 A g^{-1}	6 M KOH
$SnNi_2S_4$[2]	1483.8 F g^{-1}	2 A g^{-1}	2 M KOH
Hollow sphere NiS_2[3]	1382.0 F g^{-1}	1 A g^{-1}	2 M KOH
NiS_2[4]	695 F g^{-1}	1.25 A g^{-1}	3 M KOH
NiS_2/ZnS[5]	1198 F g^{-1}	1 A g^{-1}	3 M KOH
NiS-$NiCo_2O_4$@C[6]	1411 F g^{-1}	1 A g^{-1}	6 M KOH
C@MoS_2/Ni_3S_4[7]	951.3 F g^{-1}	2 A g^{-1}	2 M KOH
NiS/ACNTs[8]	1266 F g^{-1}	1 A g^{-1}	3 M KOH
Co-NiS/NCDs[9]	2480 F g^{-1}	1 A g^{-1}	3 M KOH
graphene/NiS_2	478.1 F g^{-1}	0.5 A g^{-1}	6 M KOH
NS	2221.4 F g^{-1}	1 A g^{-1}	2 M KOH
2% CoNS	2874.6 F g^{-1}	1 A g^{-1}	2 M KOH
0.5% MnNS	2612.5 F g^{-1}	1 A g^{-1}	2 M KOH
0.5% AgNS	2587.3 F g^{-1}	1 A g^{-1}	2 M KOH

6.Comparison of energy density as asymmetric supercapacitor in this work and other previous reports.

Table S5 Comparison of energy density asymmetric supercapacitor with similar nickel sulfides

Sample	Energy density	Power density
N2//N2[10]	9.00 Wh Kg^{-1}	233.0 W Kg^{-1}
NiCo2S4/CC//AC/CC[11]	25.2 Wh Kg^{-1}	799.6 W Kg^{-1}
Ni–Co LDH/STSC-0-800//a-STSC-1-600[12]	23.5 Wh Kg^{-1}	959.7 W Kg^{-1}
Ni/Co MOF//AC[13]	12.8 Wh Kg^{-1}	372.5 W Kg^{-1}
NCO//AC[14]	15.8 Wh Kg^{-1}	1385 W Kg^{-1}
MoS2/NiS//AC[15]	9.80 Wh Kg^{-1}	1524 W Kg^{-1}
NS//rGO(this work)	20.8 Wh Kg^{-1}	800 W Kg^{-1}
	17.5 Wh Kg^{-1}	1600 W Kg^{-1}
	10.0 Wh Kg^{-1}	4000 W Kg^{-1}
	6.40 Wh Kg^{-1}	6400 W Kg^{-1}
	5.33 Wh Kg^{-1}	8000 W Kg^{-1}
2% CoNS//rGO(this work)	36.6 Wh Kg^{-1}	800 W Kg^{-1}
	31.6 Wh Kg^{-1}	1600 W Kg^{-1}
	20.6 Wh Kg^{-1}	4000 W Kg^{-1}
	13.2 Wh Kg^{-1}	6400 W Kg^{-1}
	10.0 Wh Kg^{-1}	8000 W Kg^{-1}
0.5% MnNS//rGO(this work)	36.1 Wh Kg^{-1}	800 W Kg^{-1}

	31.5 Wh Kg^{-1}	1600 W Kg^{-1}
	18.9 Wh Kg^{-1}	4000 W Kg^{-1}
	12.4 Wh Kg^{-1}	6400 W Kg^{-1}
	9.11 Wh Kg^{-1}	8000 W Kg^{-1}
0.5% AgNS//rGO(this work)	36.0 Wh Kg^{-1}	800 W Kg^{-1}
	30.3 Wh Kg^{-1}	1600 W Kg^{-1}
	17.7 Wh Kg^{-1}	4000 W Kg^{-1}
	11.2 Wh Kg^{-1}	6400 W Kg^{-1}
	8.67 Wh Kg^{-1}	8000 W Kg^{-1}

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