Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

Sb_2Se_3 nanorods with N-doped reduced graphene oxide hybrids as high-capacity positive electrode materials for rechargeable aluminum batteries

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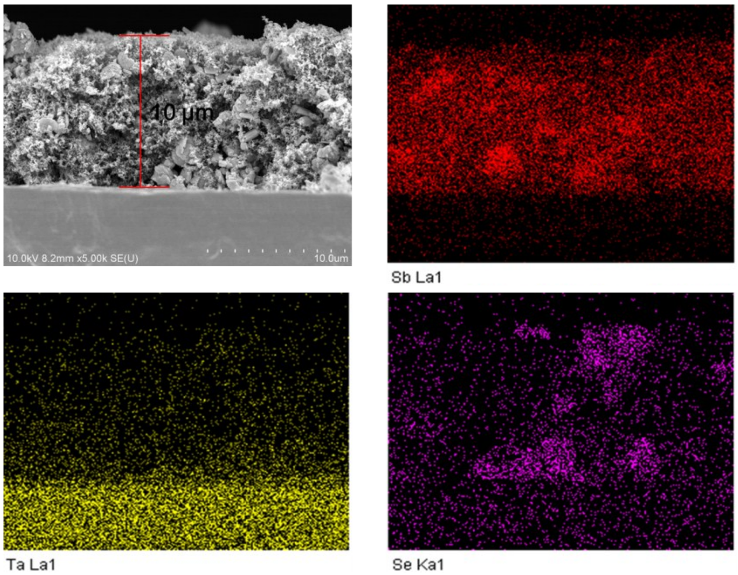


Fig. S1 The SEM images and EDS spectra of electrode.

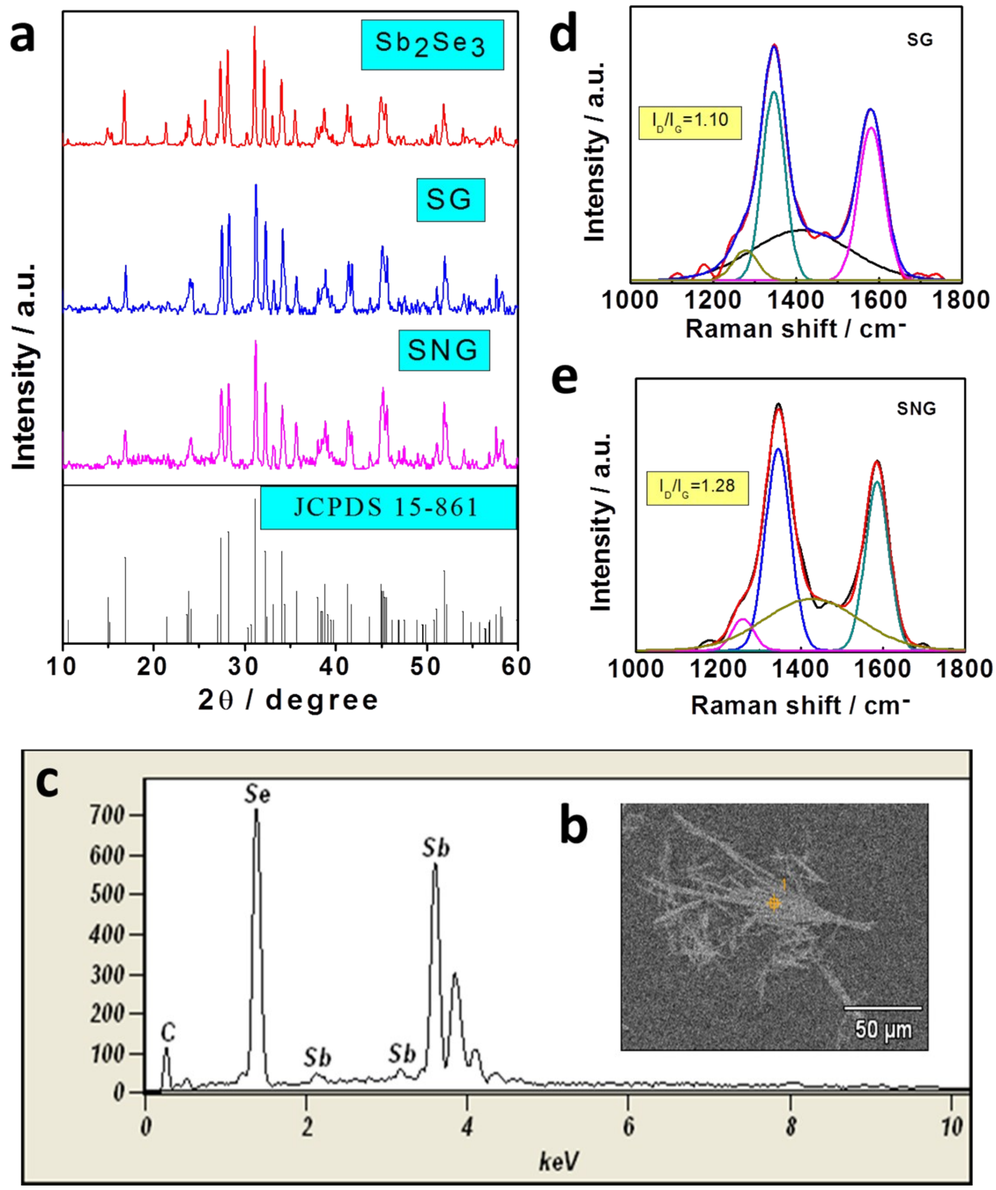


Fig. S2 (a) The XRD spectra of SNG, SG and Sb_2Se_3. (b) The SEM image of Sb_2Se_3. (c) The EDS spectra of Sb_2Se_3. (d) Raman spectrum of SG. (e) Raman spectrum of SNG.

Table S1. The weight ratio and atom ratio of Sb_2Se_3

	Se-K	***Sb-L***
Weight %	42.76	46.82

	Se-K	***Sb-L***
Atom %	30.18	21.43

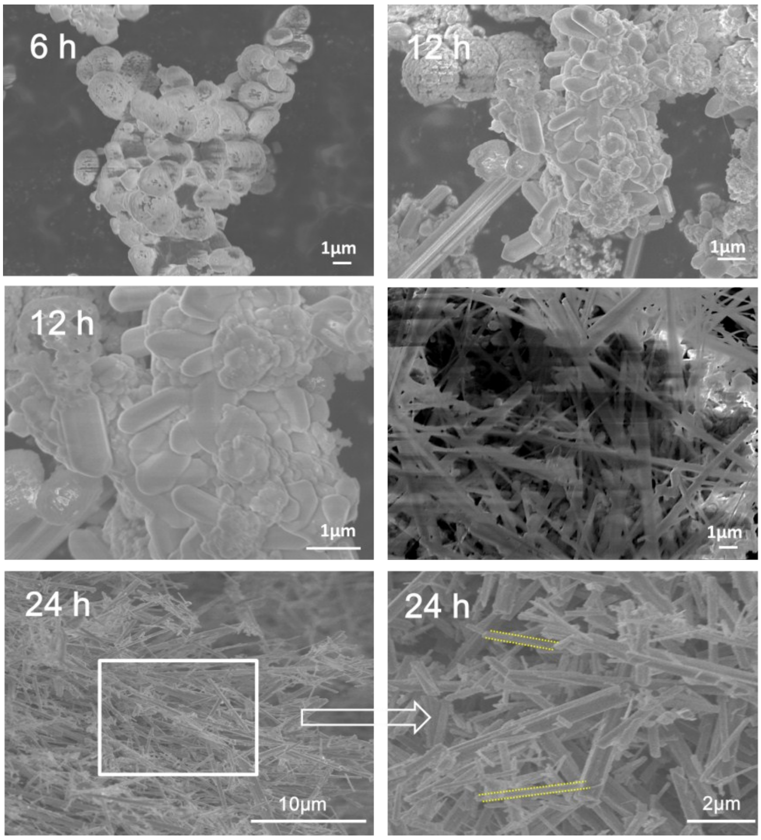


Fig. S3 SEM images of the product corresponding to different reaction times

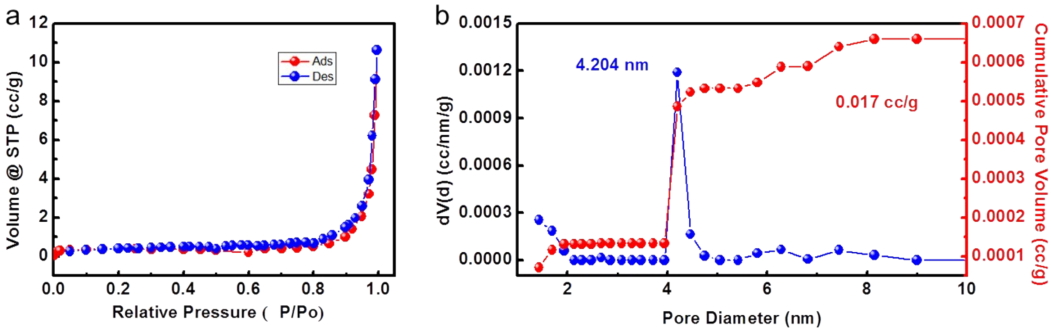


Fig. S4 (a) N_2 adsorption/desorption isotherm plots of Sb2Se3. (b) The micropore size distribution and the total mesopore volume of the samples, calculated using the BJH method

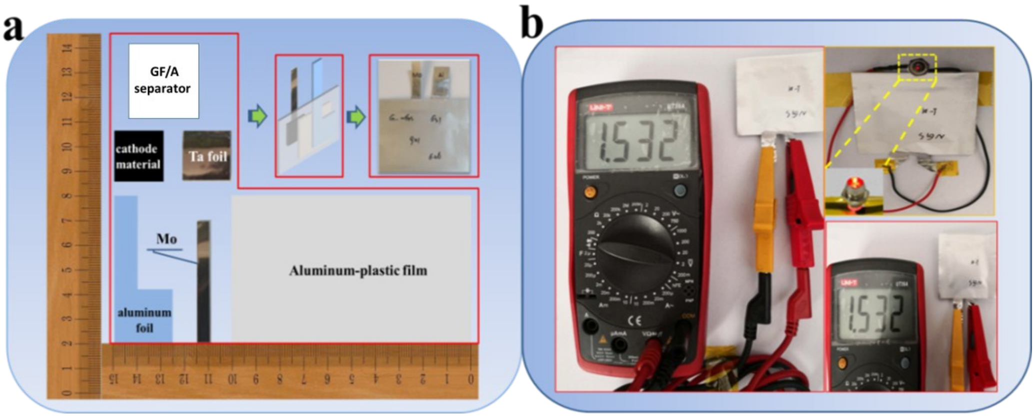


Fig. S5 (a) The assembly diagram of soft package aluminum battery. (b) Open circuit voltage of an aluminum battery based on SNG positive electrode material, and the battery can make the LED light shine.

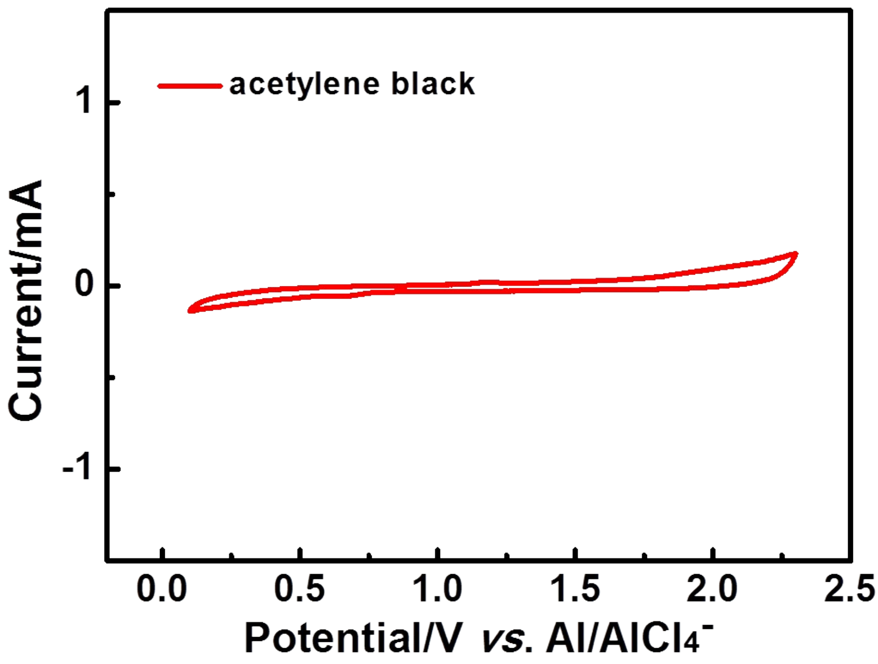


Fig. S6 The CV curves of acetylene black at a scan rate of 1 mV s^{-1}.

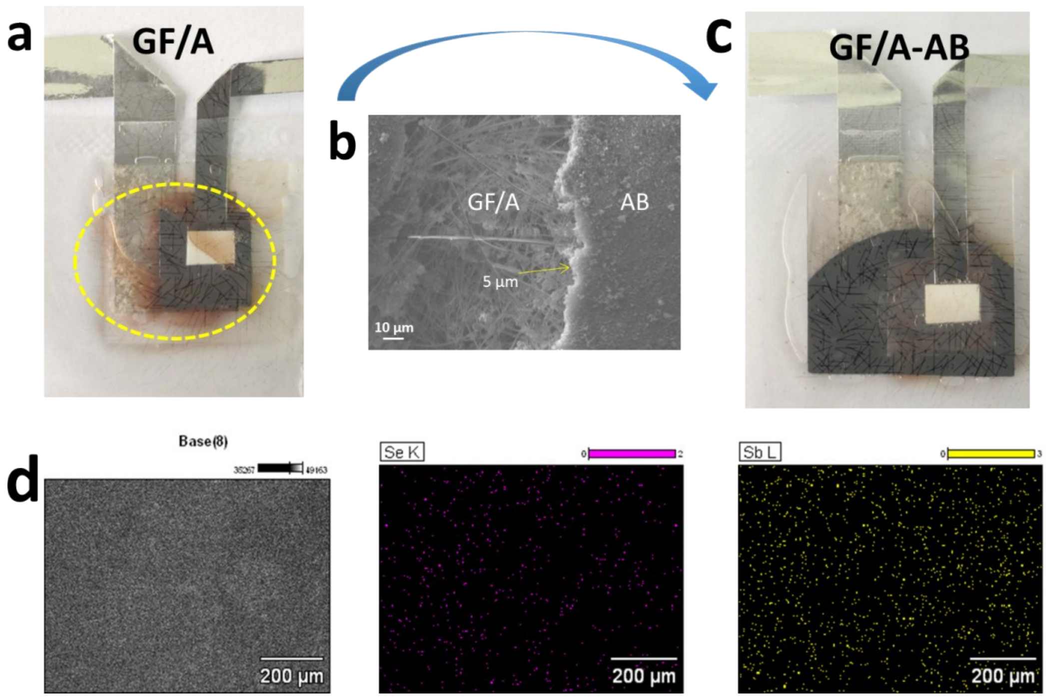


Fig. S7 (a) Ordinary separator (GF/A) is used in aluminum batteries. (b) The SEM image of modified separator (GF/A-AB). (c) Modified separator is used in aluminum batteries. (d) The EDS spectra of modified separator after 5 cycles.

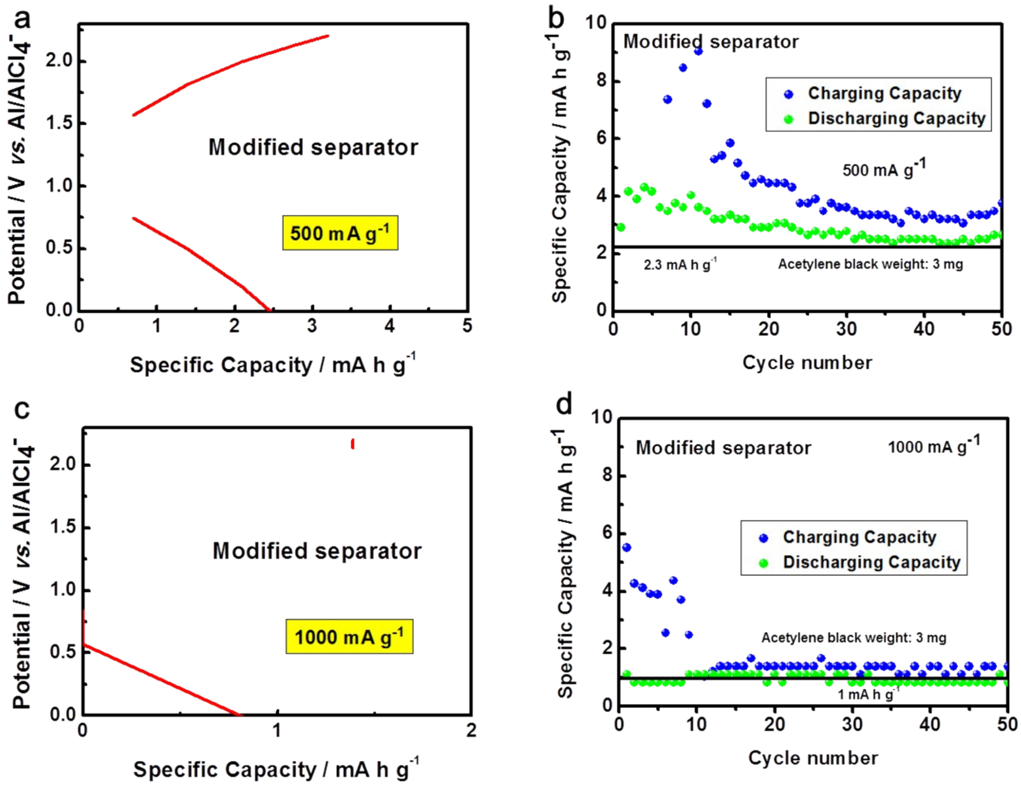


Fig. S8 (a, b) The charge and discharge curves and cycling performance of modified separator (Acetylene black) in the potential range of 0.01-2.2 V at a current density of 500 mA g^{-1}. (c, d) The charge and discharge curves and cycling performance of modified separator (Acetylene black) in the potential range of 0.01-2.2 V at a current density of 1000 mA g^{-1}.

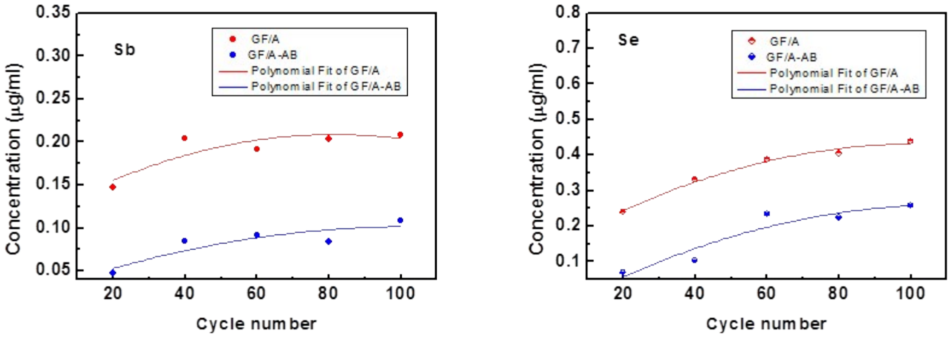


Fig. S9 ICP-determined Sb/Se specie concentration of the electrolyte of the RAIB batteries containing a Sb_2Se_3 positive electrode after different cycles.

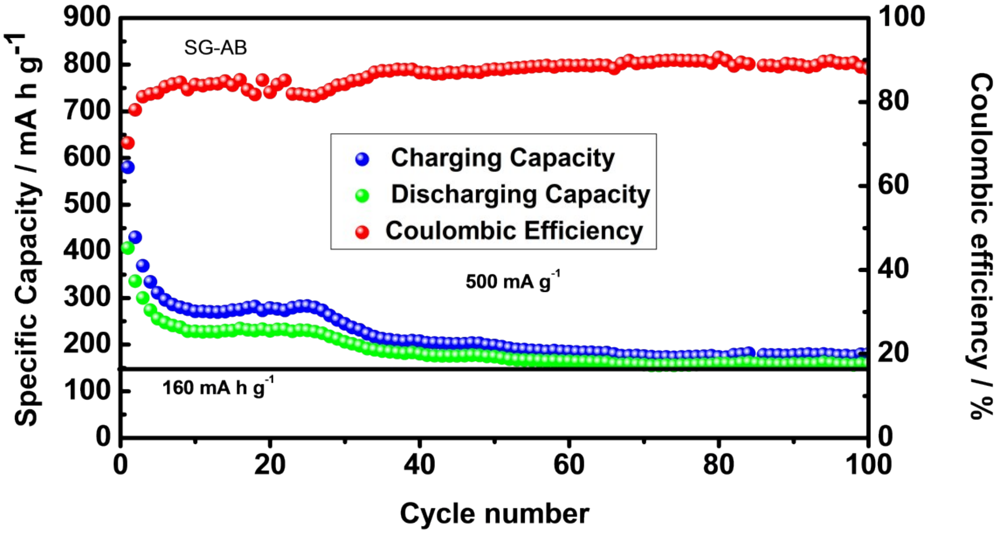


Fig. S10 The cycling performance and the Coulombic efficiency of SG-AB at a current density of 500 mA g^{-1}.

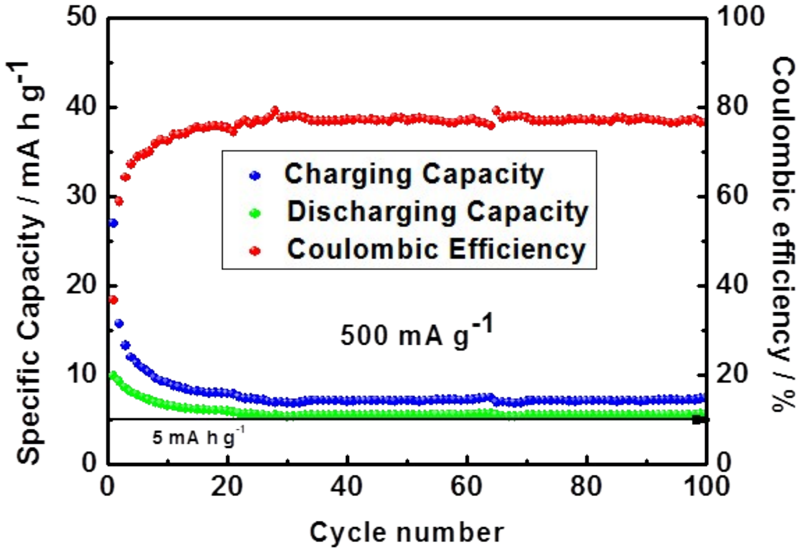


Fig. S11 The cycling performance and the Coulombic efficiency of rGO at a current density of 500 mA g^{-1}.

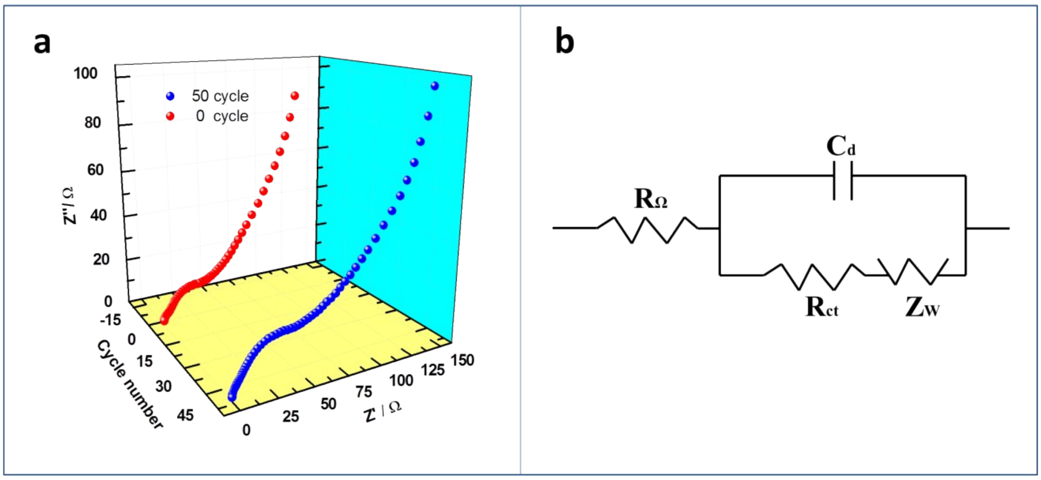


Fig. S12 (a) The electrochemical impedance spectra (EIS) of SNG electrodes before and after 50 cycles. (b) Equivalent circuit model of battery system.

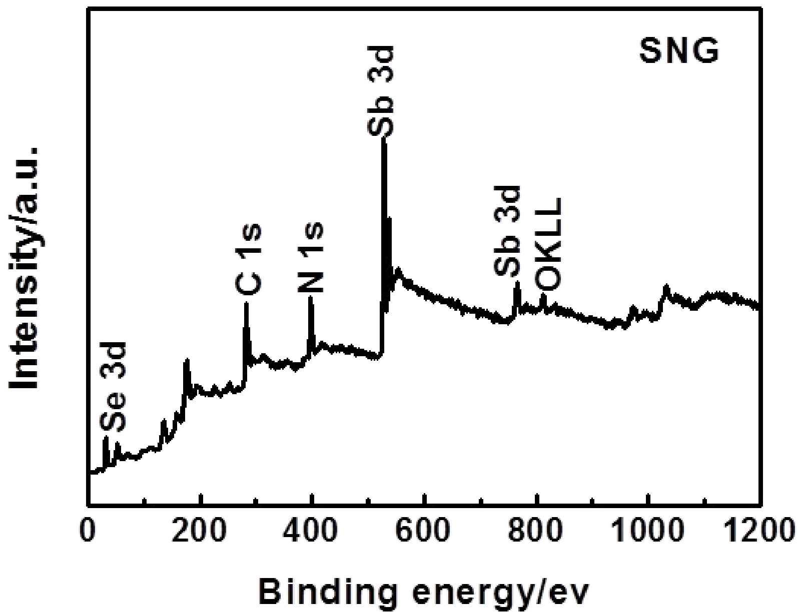


Fig. S13 XPS survey spectrum of the as-prepared SNG.

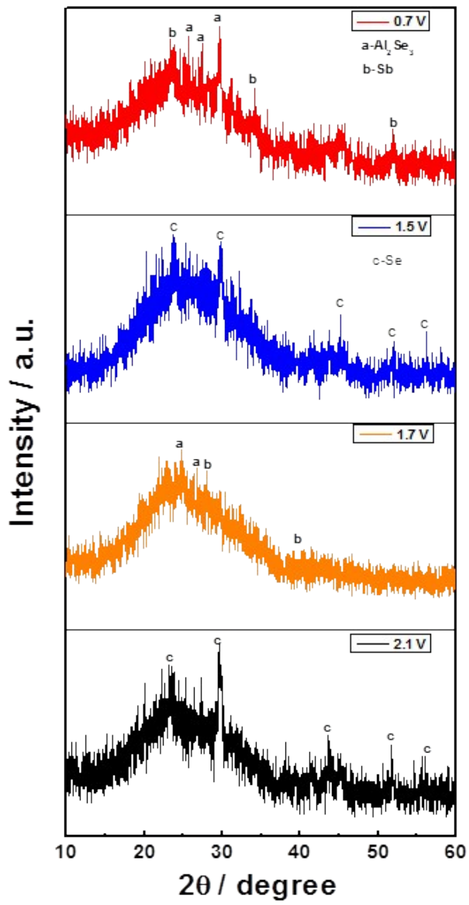


Fig. S14 Ex-situ XRD patterns of the Sb2Se3 electrode after different voltages.

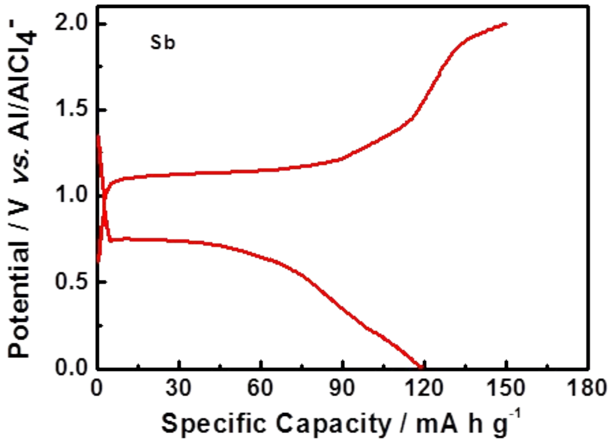
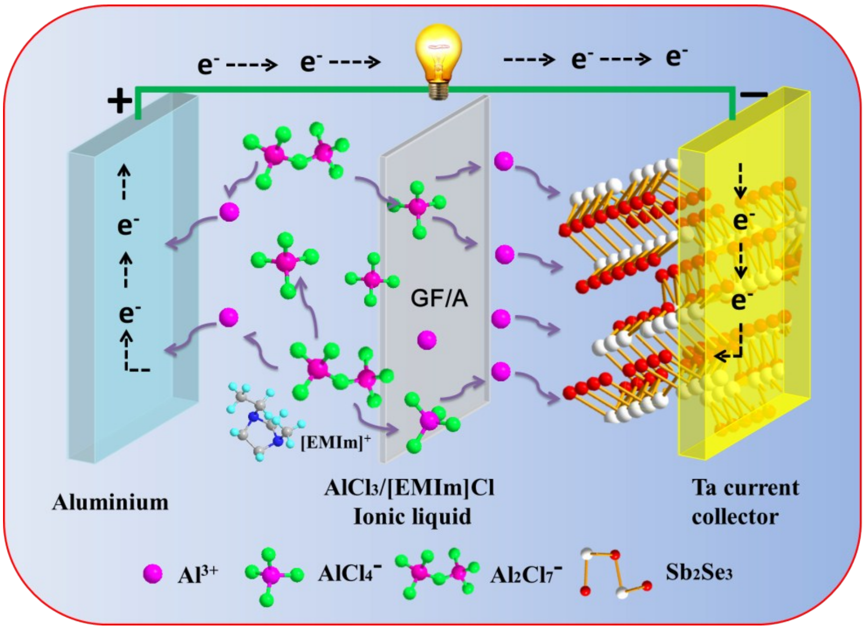


Fig. S15 The charge/discharge curves of Sb.



Scheme. S1 The schematic representation of Sb_2Se_3 as cathode for aluminum battery during discharge process.

Table S2. The theoretical redox potential calculation of Sb_2Se_3

$2\ Al + Sb_2Se_3 = Al_2Se_3 + 2\ Sb$ (n=0, m=2)				
T/℃	deltaH / KJ	deltaS / J K^{-1}	deltaG / KJ	E / V
25.000	-439.320	-21.828	-432.812	0.75

$\Delta G = -nEF$

$E = -\frac{\Delta G}{nF}$ (F=96485 C / mol, n: Transfer electron number)