*Supporting Information*

# Electrochemical Potassiation/Depotassiation Properties of Rare-Earth Antimonide/Antimony Composite Electrodes

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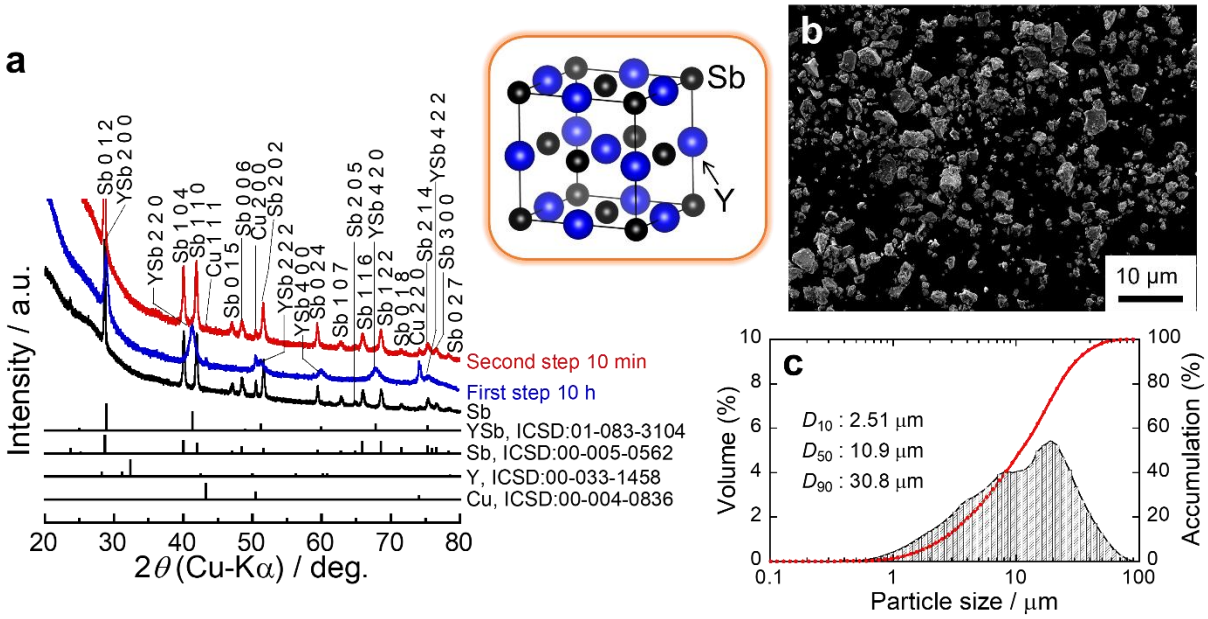


**Figure S1.** (a) XRD patterns of synthesized powder from Y and Sb with molar ratio of 1 : 1 by MA treatment for 10 hours and from YSb and Sb with weight ratio of 10 : 90 by MM treatment for 10 minutes. (b) SEM image and (c) particle size distribution of YSb/Sb.

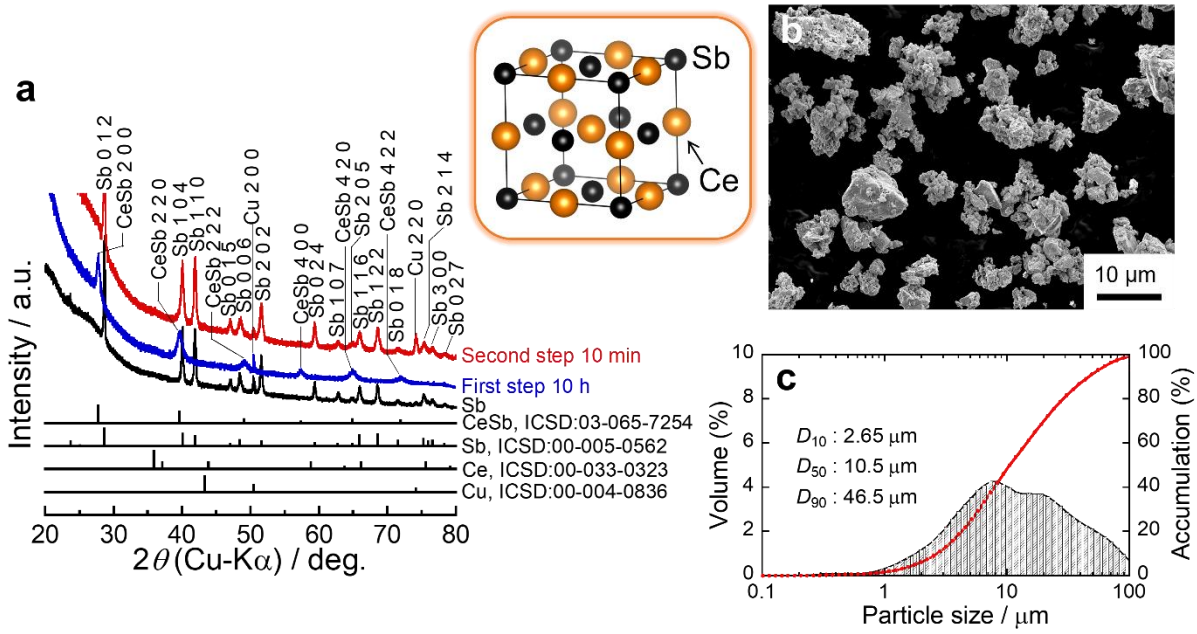


**Figure S2.** (a) XRD patterns of synthesized powder from Ce and Sb with molar ratio of 1 : 1 by MA treatment for 10 hours and from CeSb and Sb with weight ratio of 10 : 90 by MM treatment for 10 minutes. (b) SEM image and (c) particle size distribution of CeSb/Sb.

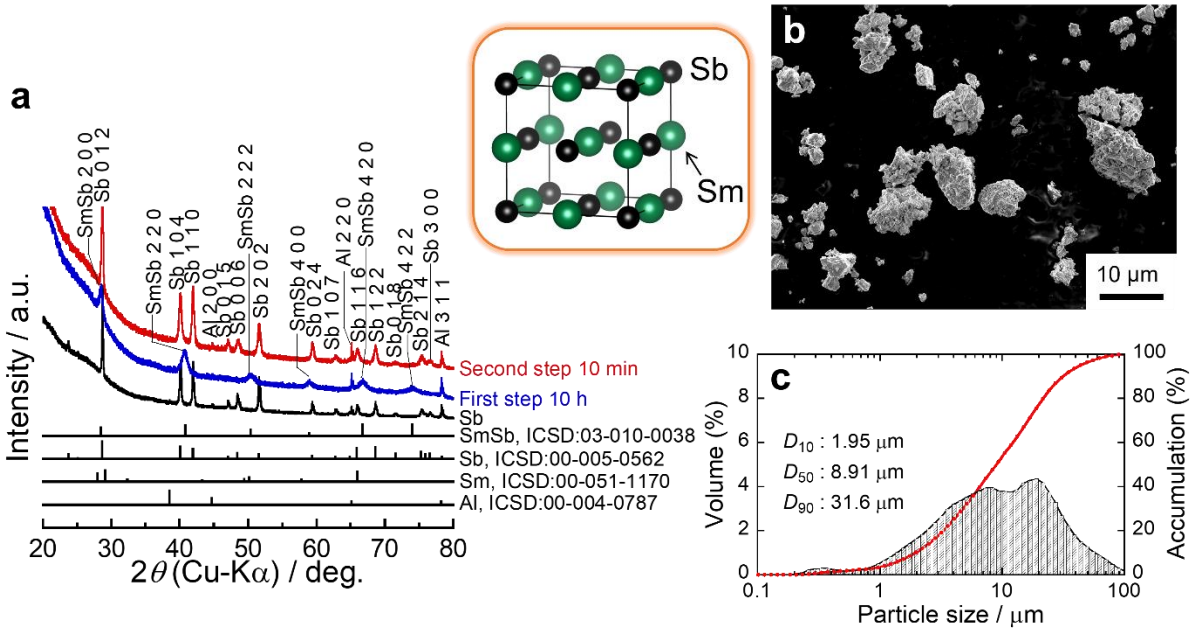


**Figure S3.** (a) XRD patterns of synthesized powder from Sm and Sb with molar ratio of 1 : 1 by MA treatment for 10 hours and from SmSb and Sb with weight ratio of 10 : 90 by MM treatment for 10 minutes. (b) SEM image and (c) particle size distribution of SmSb/Sb.

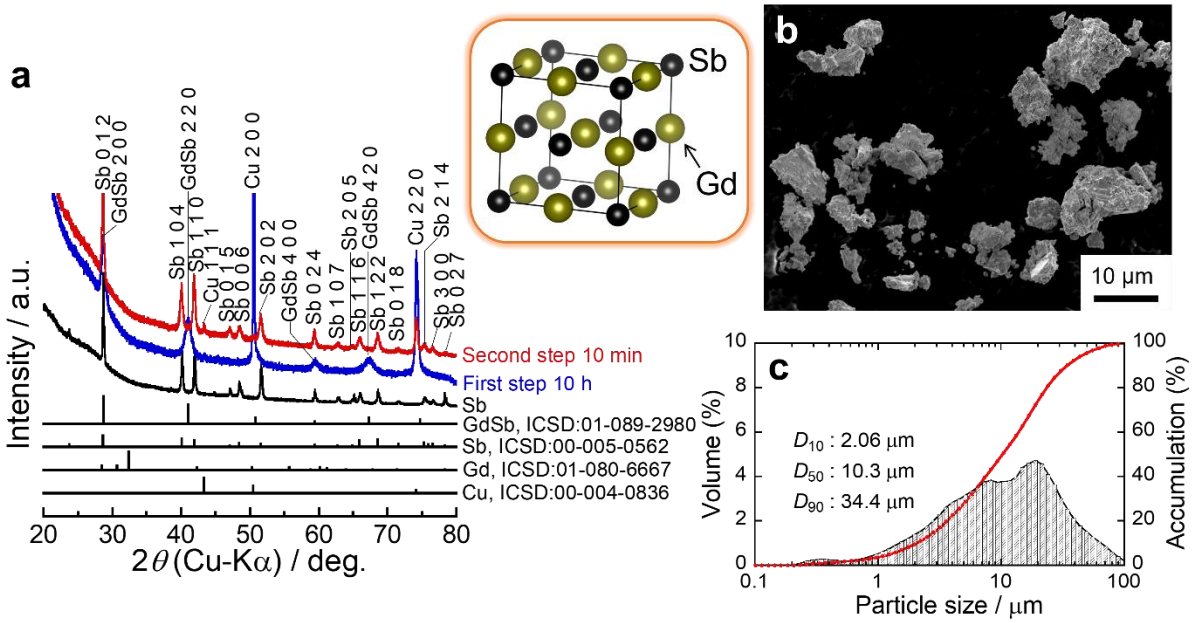


**Figure S4.** (a) XRD patterns of synthesized powder from Gd and Sb with molar ratio of 1 : 1 by MA treatment for 10 hours and from GdSb and Sb with weight ratio of 10 : 90 by MM treatment for 10 minutes. (b) SEM image and (c) particle size distribution of GdSb/Sb.

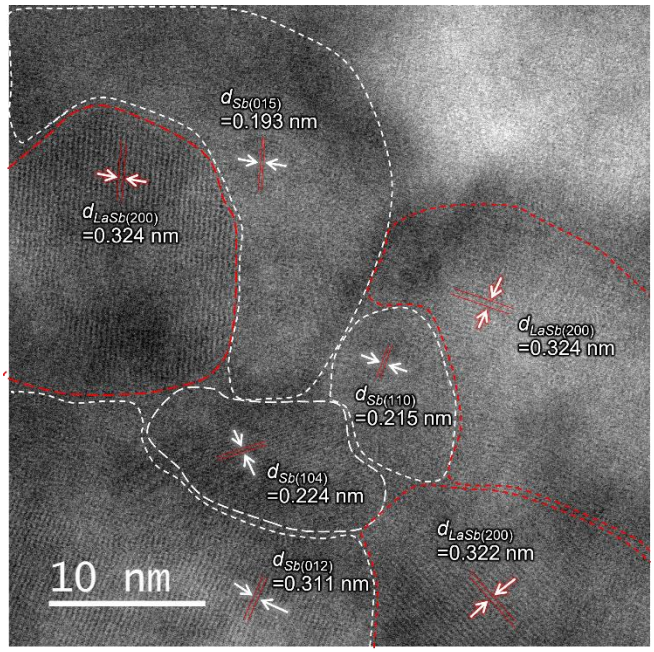


**Figure S5.** TEM image of LaSb/Sb (50/50 wt.%).

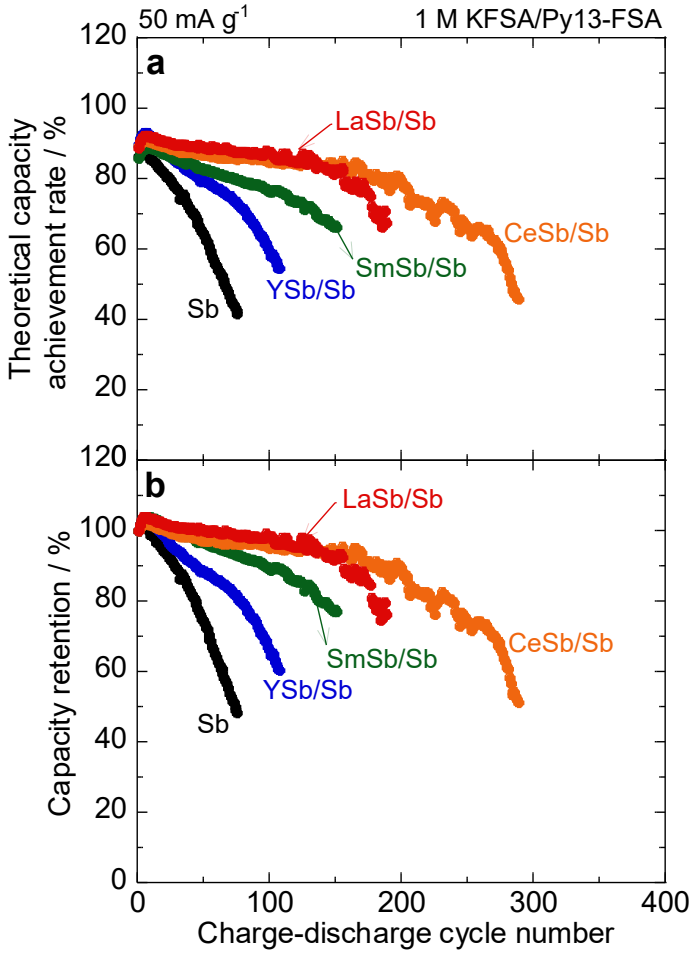


**Figure S6.** Cycle dependency of the (a) theoretical capacity achievement rate and (b) capacity retention of *RE*Sb/Sb (10/90 wt.%) composite and pure Sb electrodes.

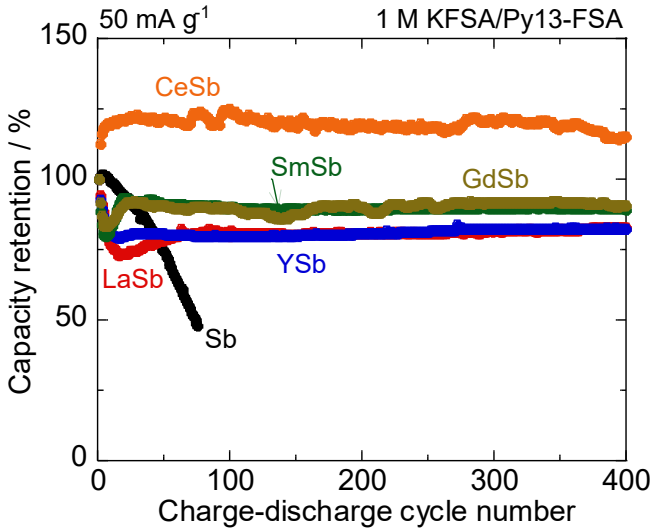


**Figure S7.** Capacity retention of pure *RE*Sb and Sb electrodes.

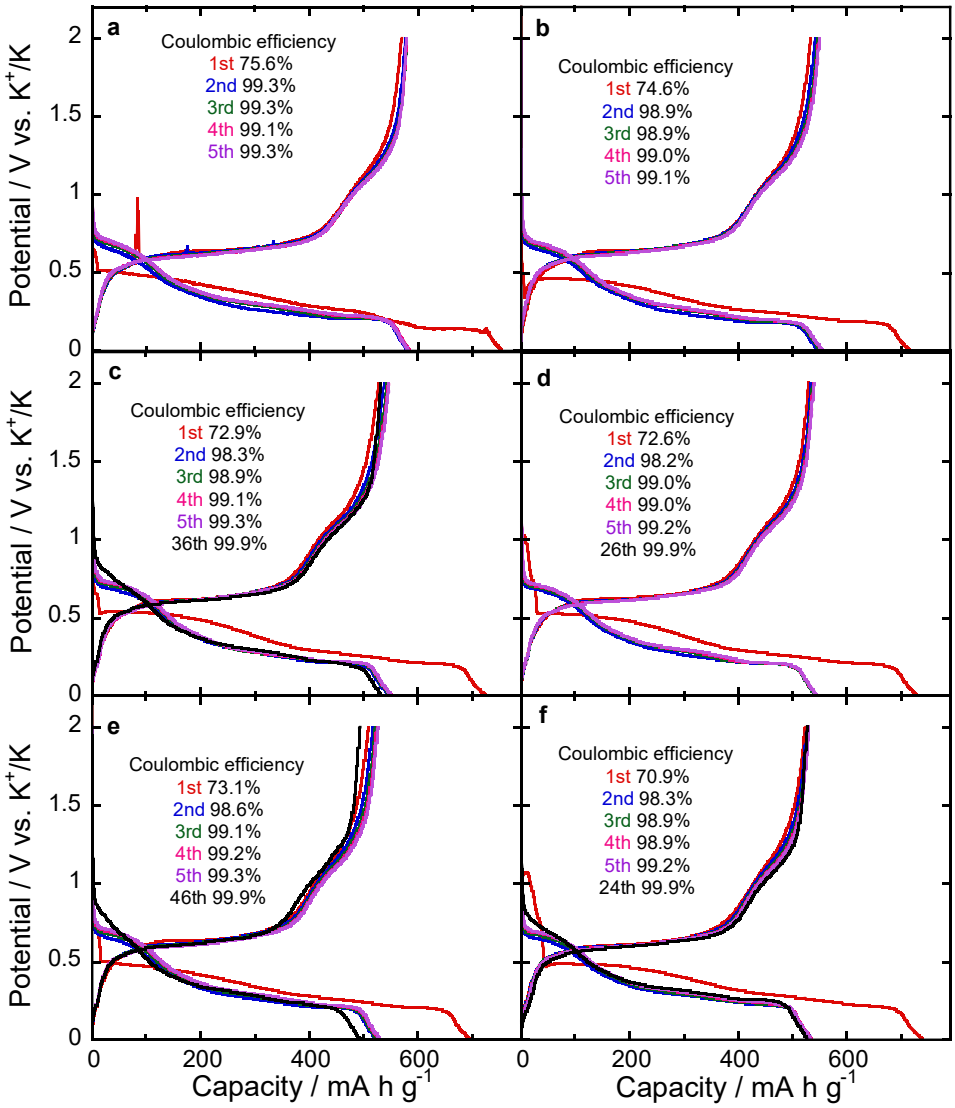


**Figure S8.** Charge–discharge profiles of (a) pure Sb, (b) YSb/Sb (10/90 wt.%), (c) LaSb/Sb (10/90 wt.%), (d) CeSb/Sb (10/90 wt.%), (e) SmSb/Sb (10/90 wt.%), and (f) GdSb/Sb (10/90 wt.%) electrode in 1 M KFSA/Py13-FSA at current density of 50 mA $g^{-1}$.

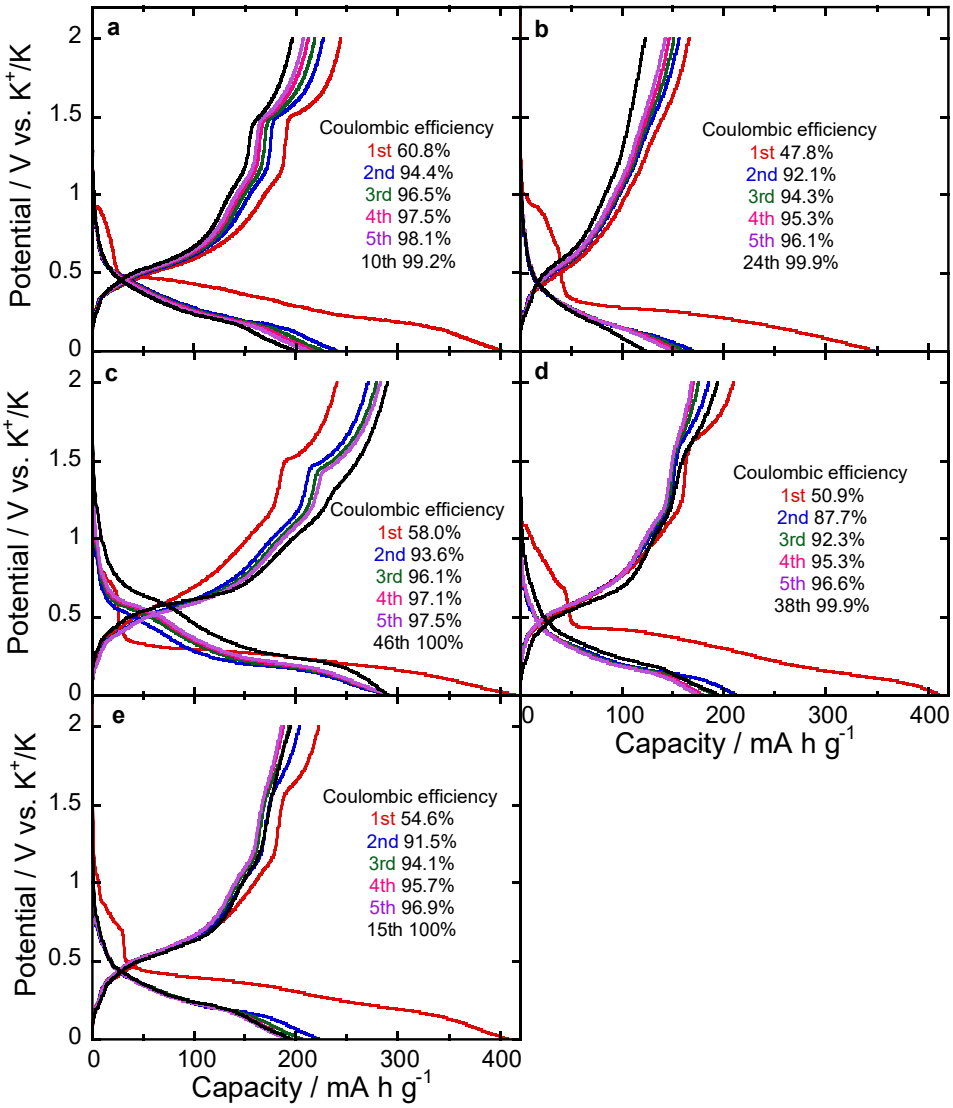


**Figure S9.** Charge–discharge profiles of (a) YSb, (b) LaSb, (c) CeSb, (d) SmSb, and (e) GdSb electrode in 1 M KFSA/Py13-FSA at current density of 50 mA $g^{-1}$.

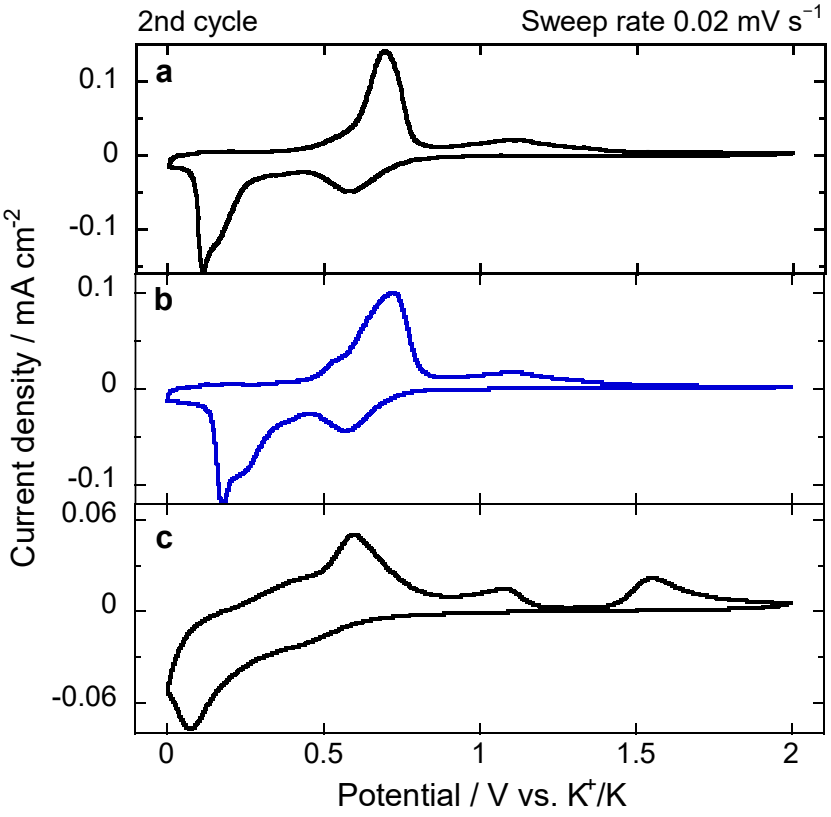


**Figure S10.** Cyclic voltammograms of (a) Sb, (b) YSb/Sb (10/90 wt.%), and (c) YSb electrodes.

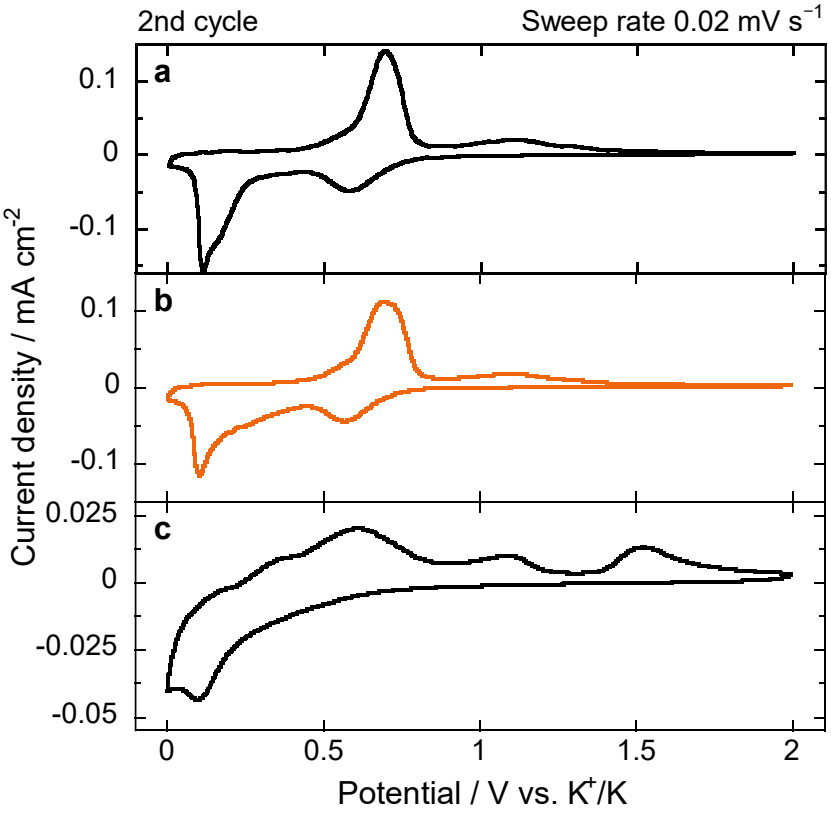


**Figure S11.** Cyclic voltammograms of (a) Sb, (b) CeSb/Sb (10/90 wt.%), and (c) CeSb electrodes.

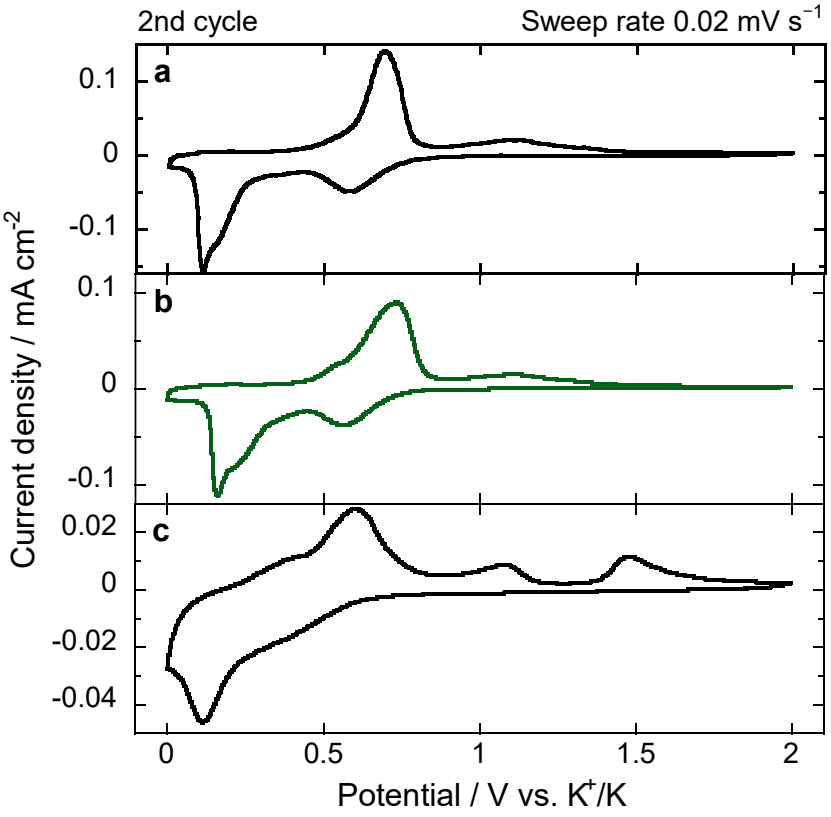


**Figure S12.** Cyclic voltammograms of (a) Sb, (b) SmSb/Sb (10/90 wt.%), and (c) SmSb electrodes.

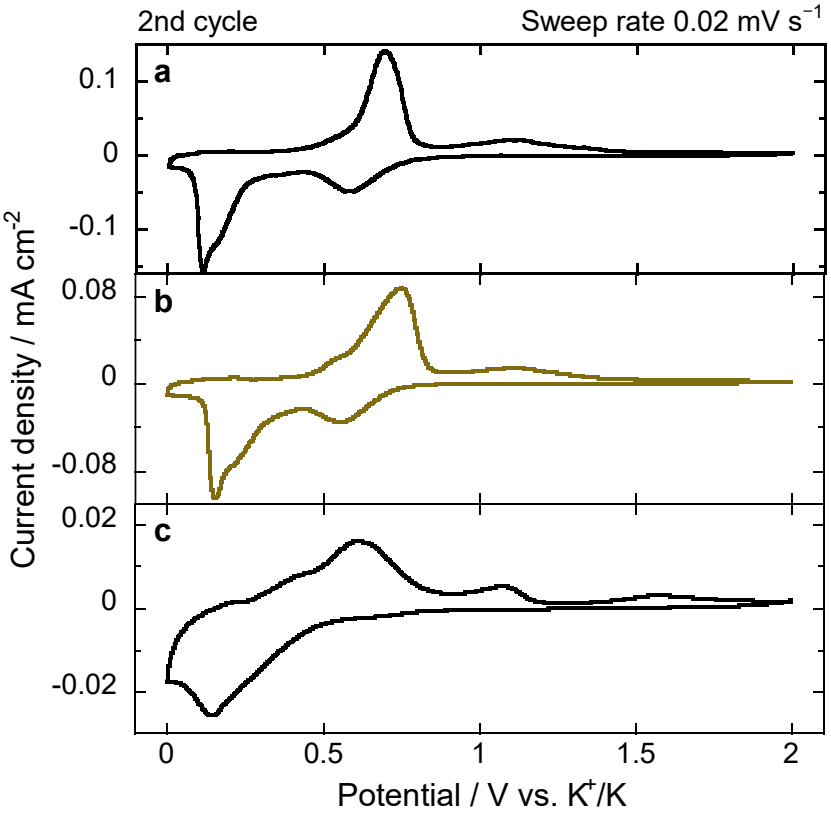


**Figure S13.** Cyclic voltammograms of (a) Sb, (b) GdSb/Sb (10/90 wt.%), and (c) GdSb electrodes.

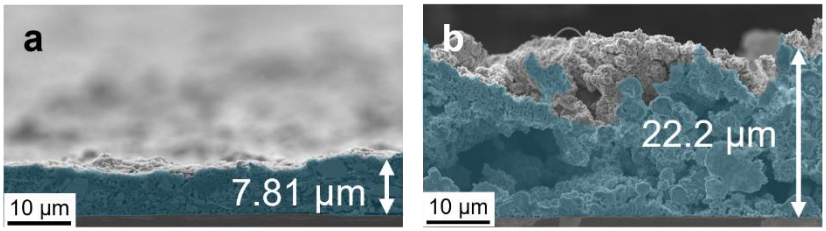


**Figure S14.** Cross−sectional SEM image of pure Sb electrode (a) before and (b) after 50th cycle.

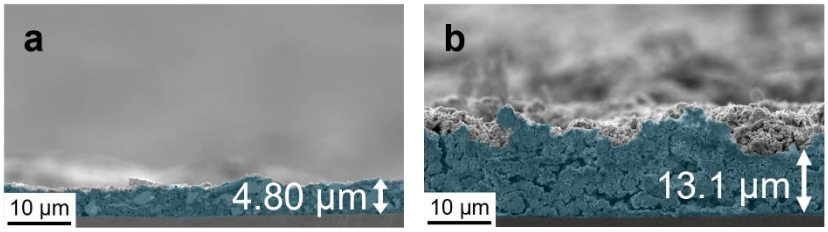


**Figure S15.** Cross−sectional SEM image of YSb/Sb (10/90 wt.%) electrode (a) before and (b) after 50th cycle.

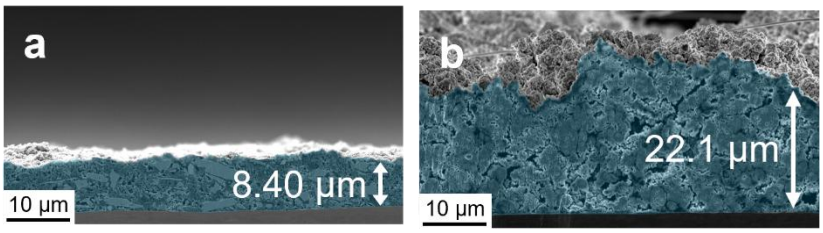


**Figure S16.** Cross−sectional SEM image of GdSb/Sb (10/90 wt.%) electrode (a) before and (b) after 50th cycle.

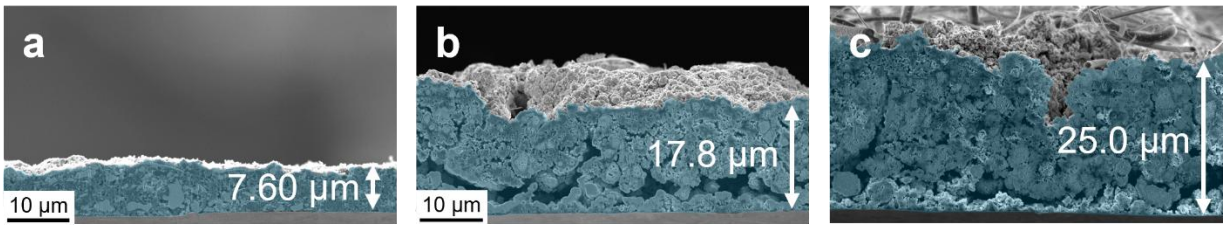


**Figure S17.** Cross−sectional SEM image of SmSb/Sb (10/90 wt.%) electrode (a) before and after (b) 50th and (c) 100th cycles.

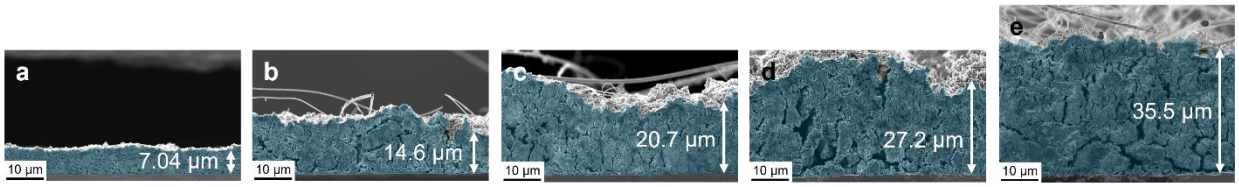


**Figure S18.** Cross−sectional SEM image of LaSb/Sb (10/90 wt.%) electrode (a) before and after (b) 50th, (c) 100th, (d) 125th, and (e) 150th cycles.

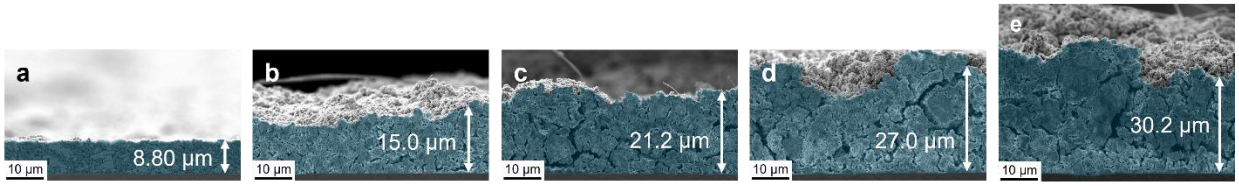


**Figure S19.** Cross−sectional SEM image of CeSb/Sb (10/90 wt.%) electrode (a) before and after (b) 50th, (c) 100th, (d) 125th, and (e) 150th cycles.

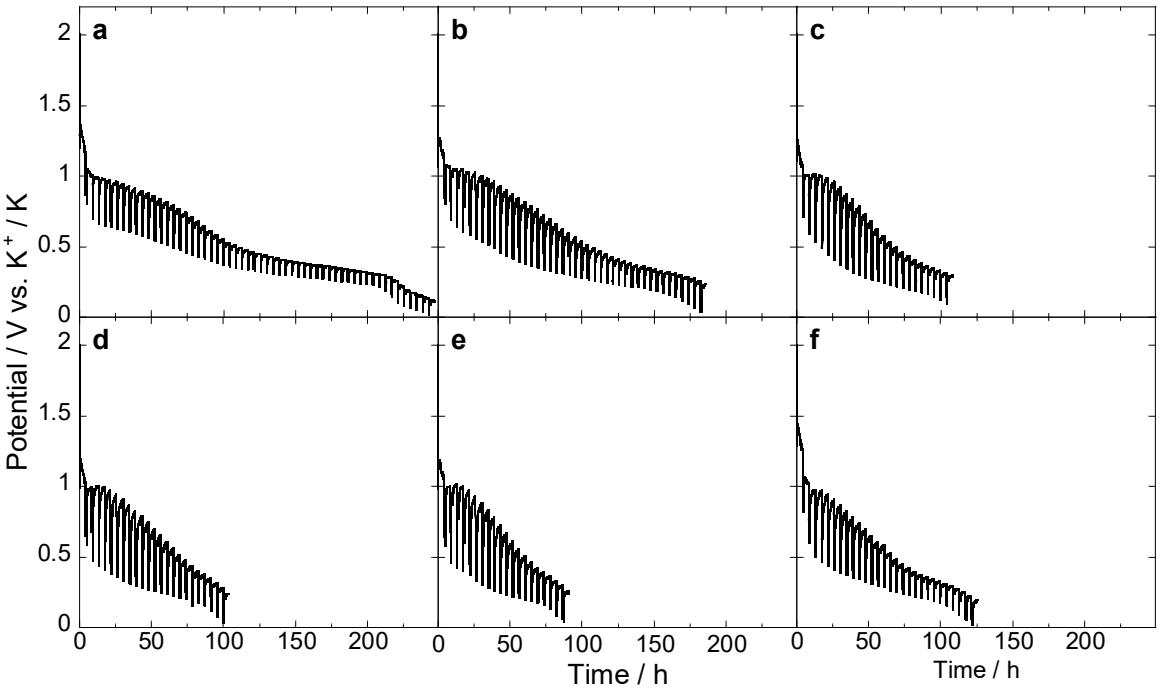


**Figure S20.** GITT curves of (a) pure Sb, (b) YSb, (c) GdSb, (d) SmSb, (e) LaSb, and (f) CeSb electrodes.

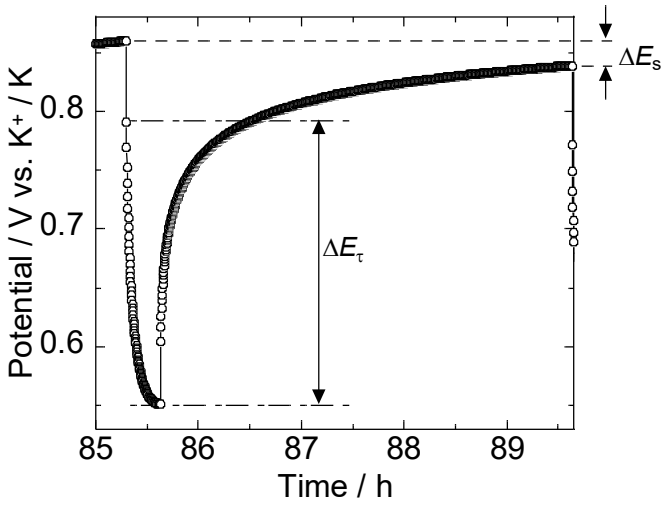


**Figure S21.** Enlarged GITT curve of pure Sb electrode.

**Table S1**. Summary of lattice parameter and potassiation potential of each *RE*Sb$_x$.

| Materials | LaSb | CeSb | SmSb | GdSb | YSb | Sb |
|---|---|---|---|---|---|---|
| Crystal system | Cubic | Cubic | Cubic | Cubic | Cubic | Trigonal |
| Lattice constant / nm | 0.649 | 0.642 | 0.627 | 0.622 | 0.618 | a=b=0.435<br>c=1.149 |
| Volume / nm$^3$ | 0.273 | 0.265 | 0.246 | 0.241 | 0.236 | 0.217 |
| Potassiation potential / V vs. $K^+/K$ | 0.65–0.01 | 0.78–0.03 | 0.61–0.01 | 0.78–0.03 | 0.56–0.01 | 0.77–0.46<br>0.26–0.06 |