Electronic Supplementary Material (ESI) for Chemical Science.

Electrochemical Intercalation of Rubidium into Graphite, Hard Carbon, and Soft Carbon

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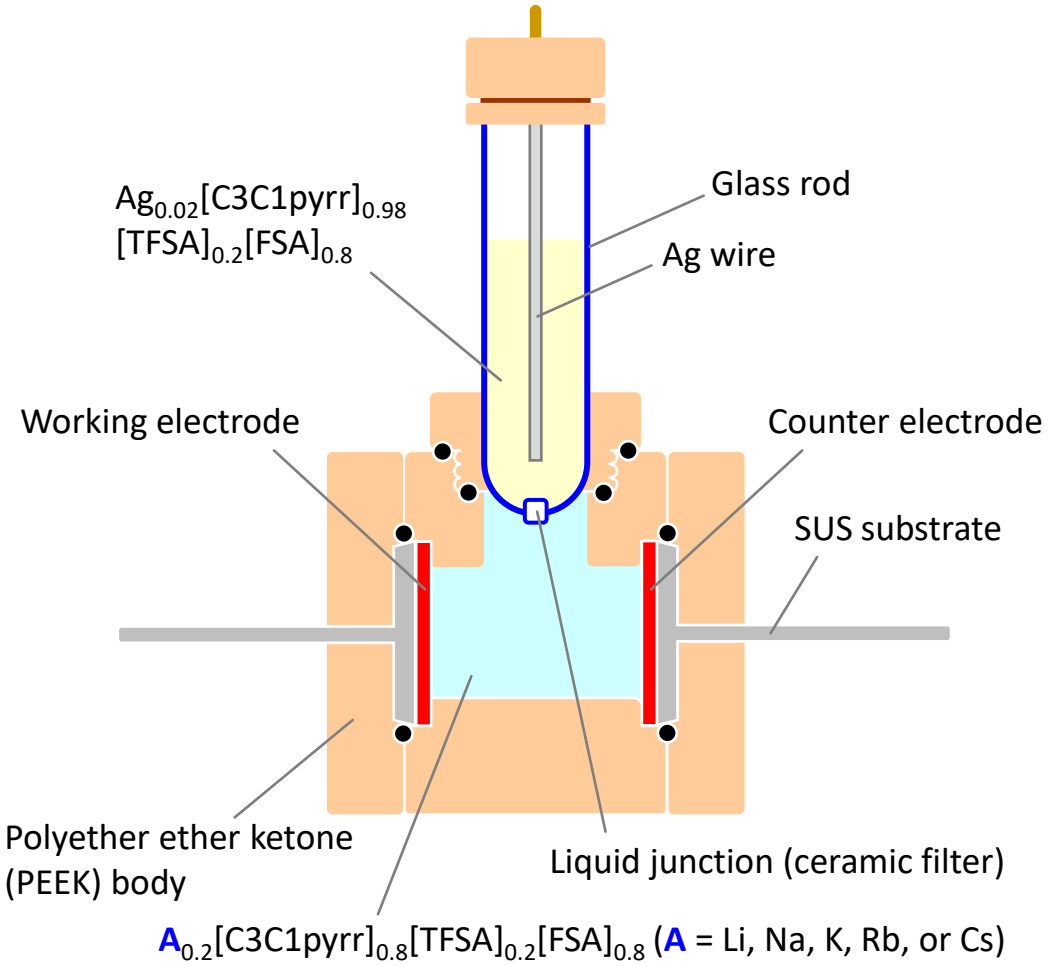

Fig. S1 Illustration of two-compartment cell used for the measurement of A^+/A electrode potential. Note that non-essential parts are omitted in the illustration. The black circles in the illustration represent cross sections of the O-rings made of EPDM (ethylene propylene diene monomer) rubber that keep the airtightness of the cell.

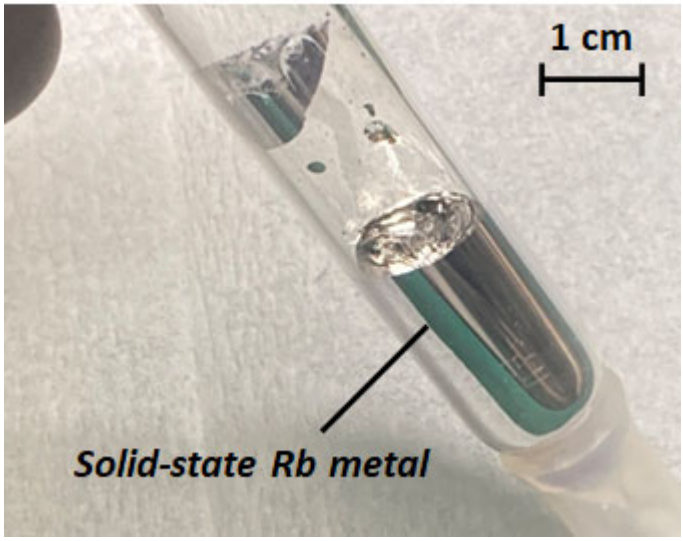

Fig. S2 Photograph of commercially available Rb metal in a glass ampoule.

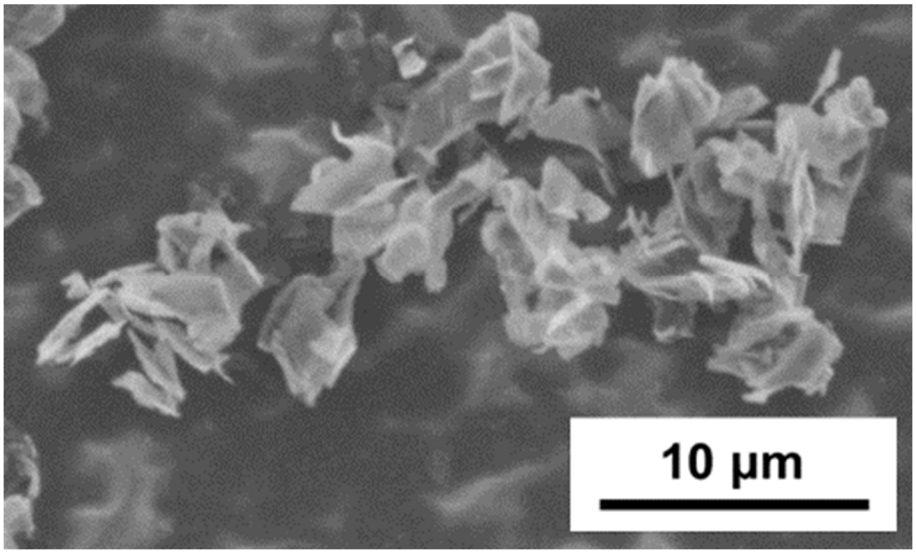

Fig. S3 Typical SEM image of the natural graphite used in this study.

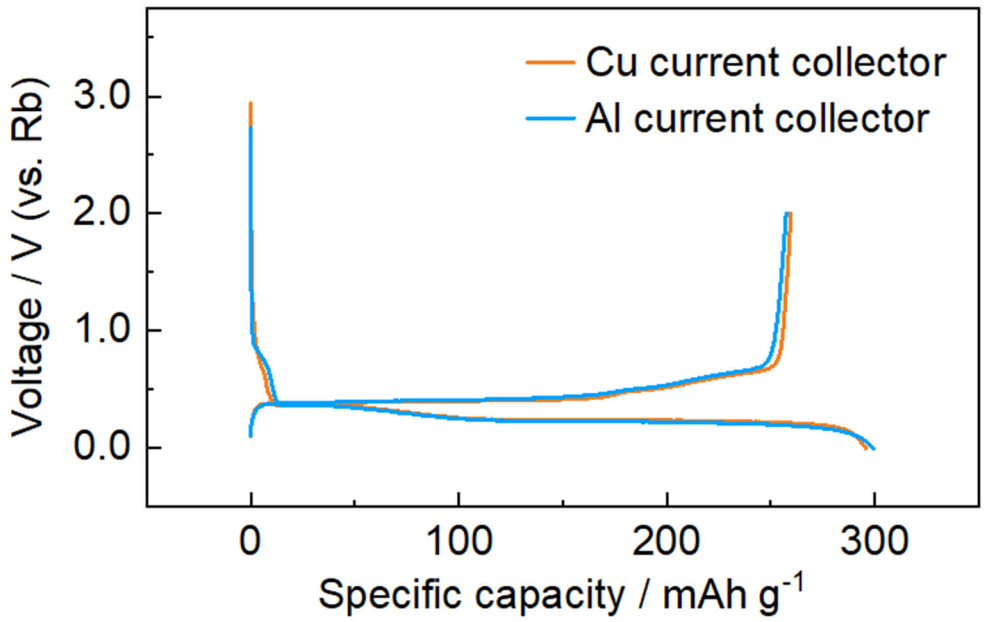

Fig. S4 Initial galvanostatic reduction–oxidation curves of graphite electrodes with different current collector in Rb cells.

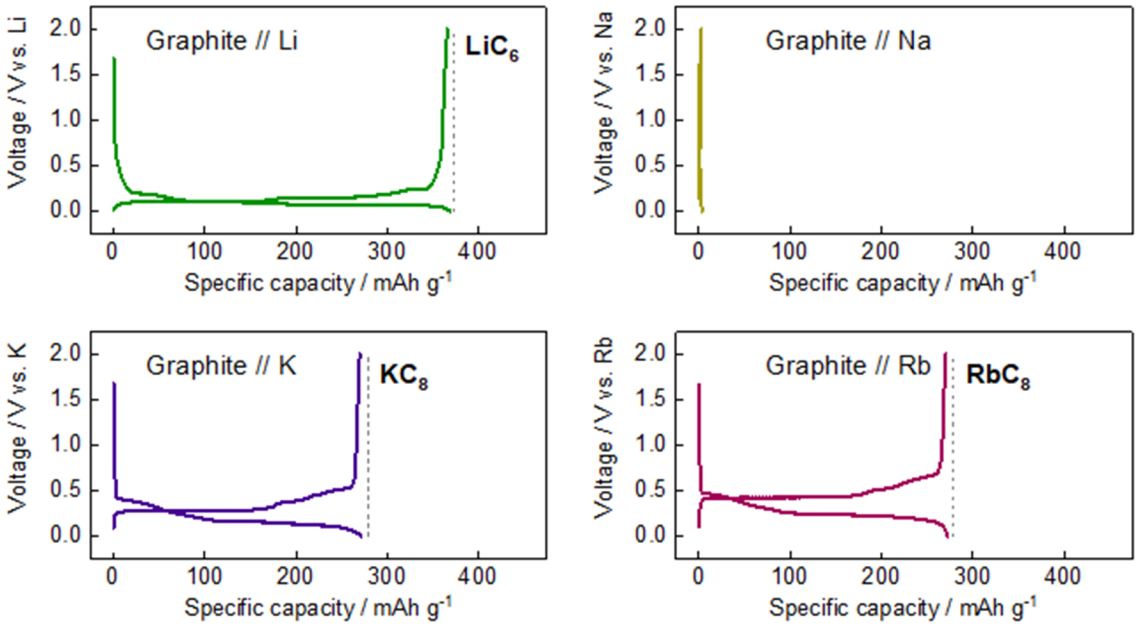

Fig. S5 Galvanostatic reduction–oxidation curves of graphite electrodes with $A_2[C_3C_1pyrr]_{0.8}[TFSA]_{0.2}[FSA]_{0.8}$ electrolyte and alkali-metal counter electrode.

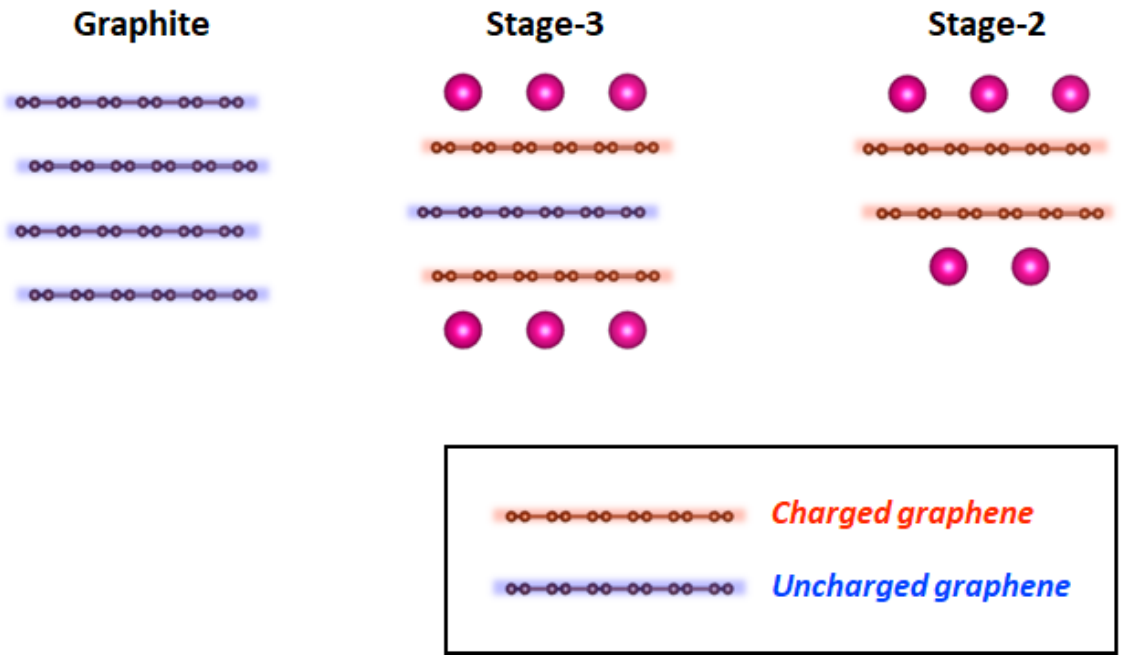

Fig. S6 Schematic of charged and uncharged graphene in Rb-GICs.

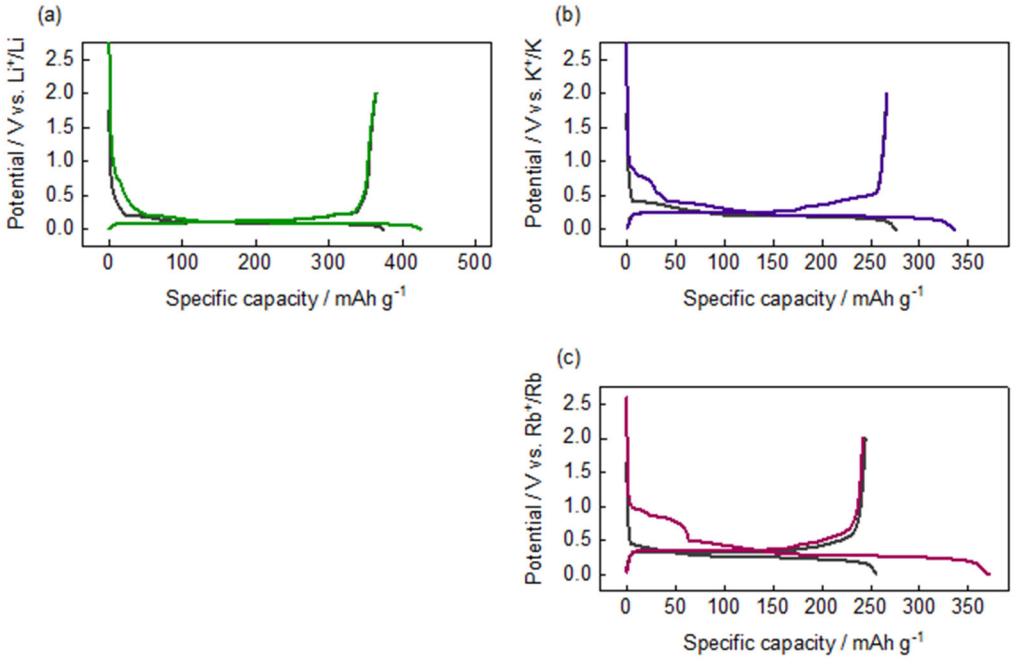

Fig. S7 Galvanostatic reduction–oxidation curves of graphite electrode in three-electrode (a) Li, (b) K, and (c) Rb cells at current density of C/30; samples were further subjected to in-situ XRD analysis.

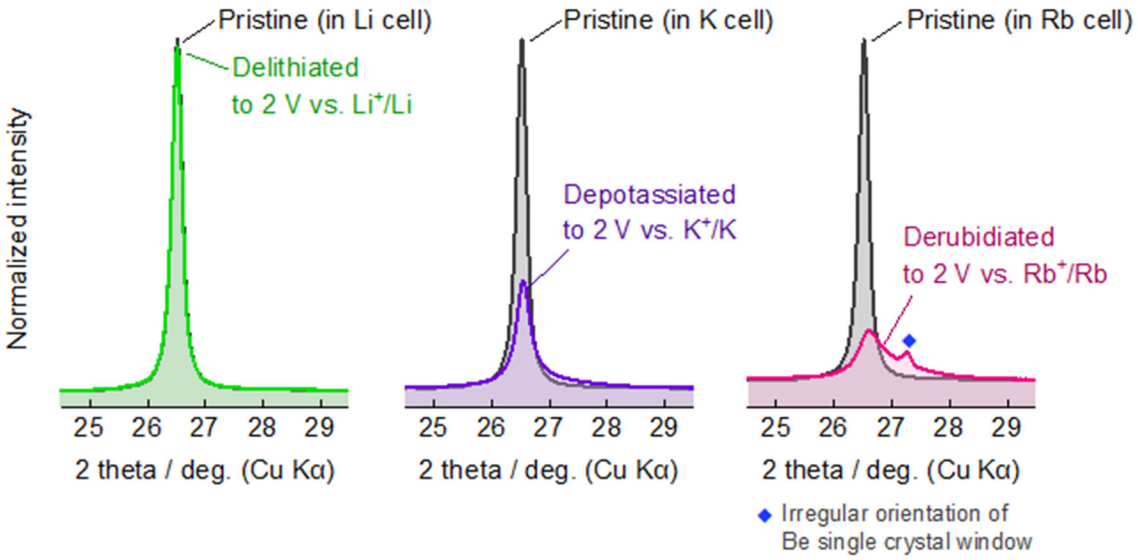

Fig. S8 In-situ XRD patterns of graphite electrodes in pristine and dealkaliated states at 2 V vs. A^+/A in the 1st cycle.

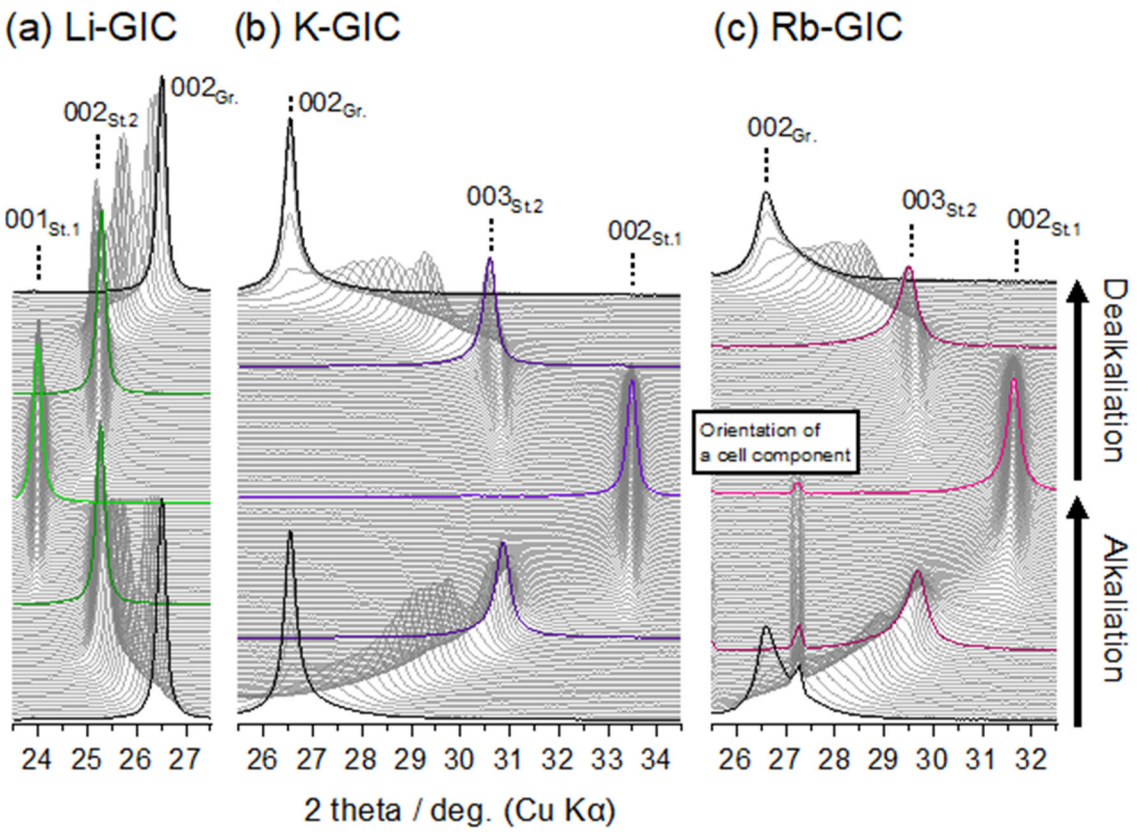

Fig. S9 Operando XRD patterns of graphite electrodes during 2nd cycle in (a) Li, (b) K, and (c) Rb cells.

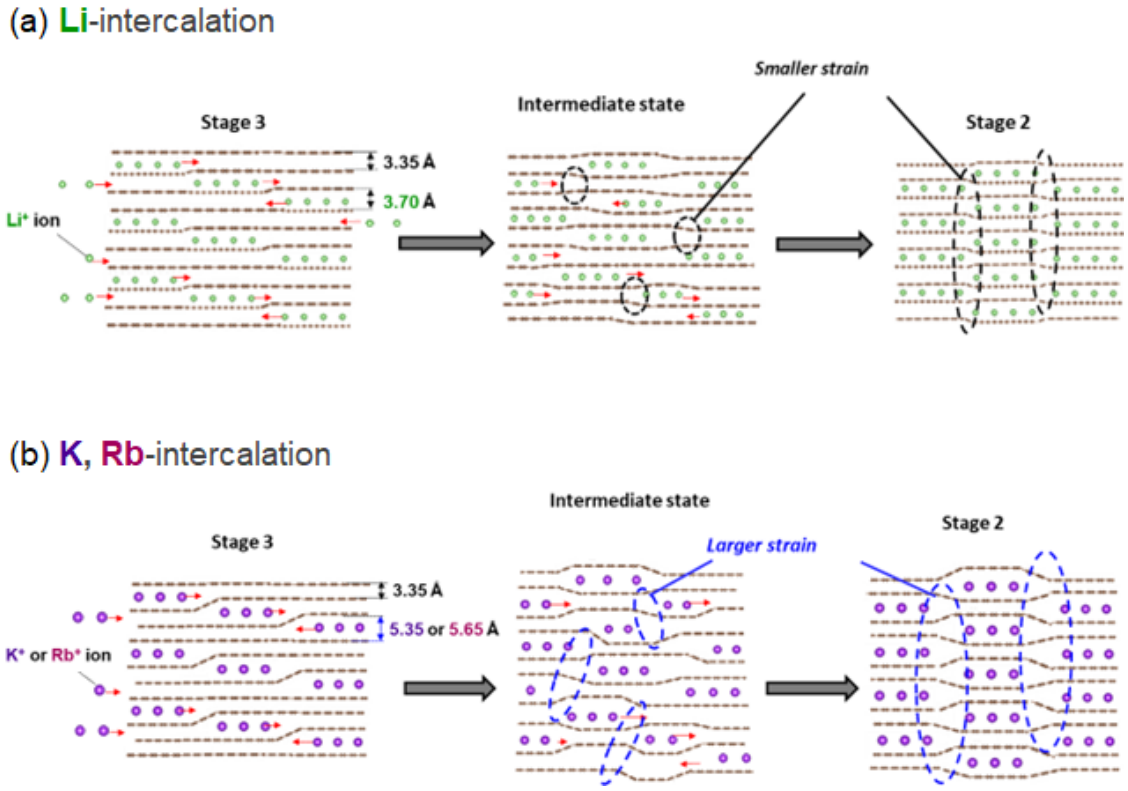

Fig. S10 Schematic of the assumed phase changes of (a) Li -GICs and (b) larger alkali-metal (K or Rb) –GICs based on the Daumas-Hérold model.

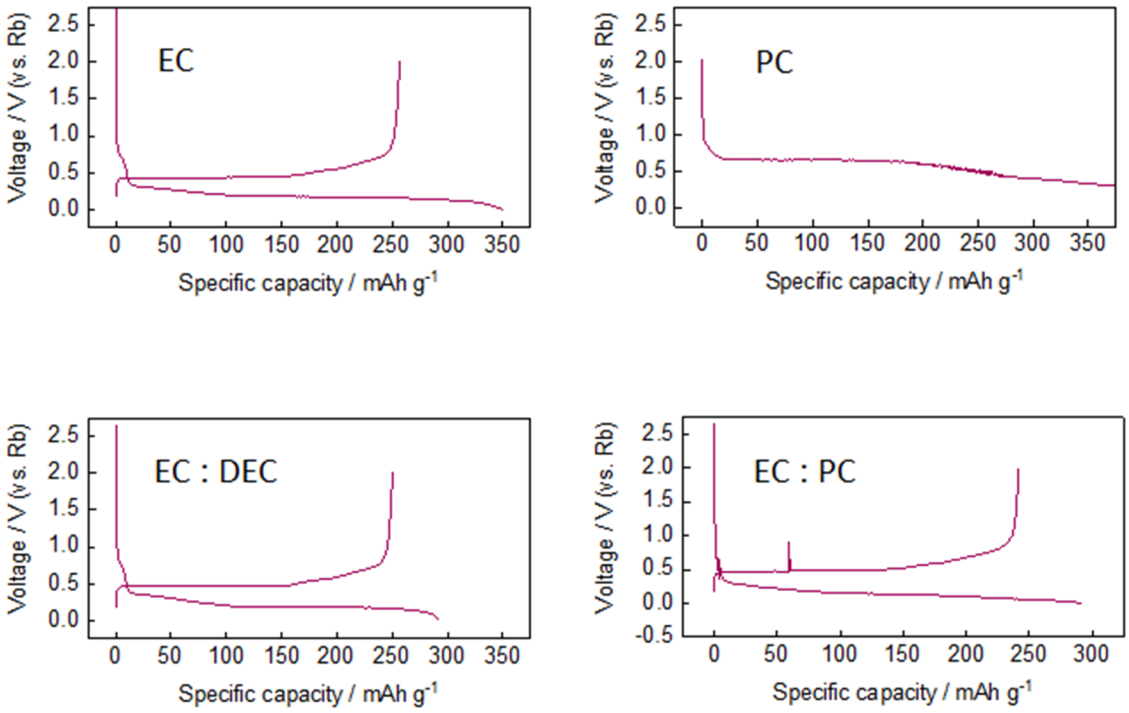

Fig. S11 Voltage–capacity curves of graphite // Rb cells in (a) 1 mol kg^{-1} RbTFSA/EC, (b) 1 mol kg^{-1} RbTFSA/PC, (c) 1 mol kg^{-1} RbTFSA/EC:DEC, (d) 1 mol kg^{-1} RbTFSA/EC:PC.

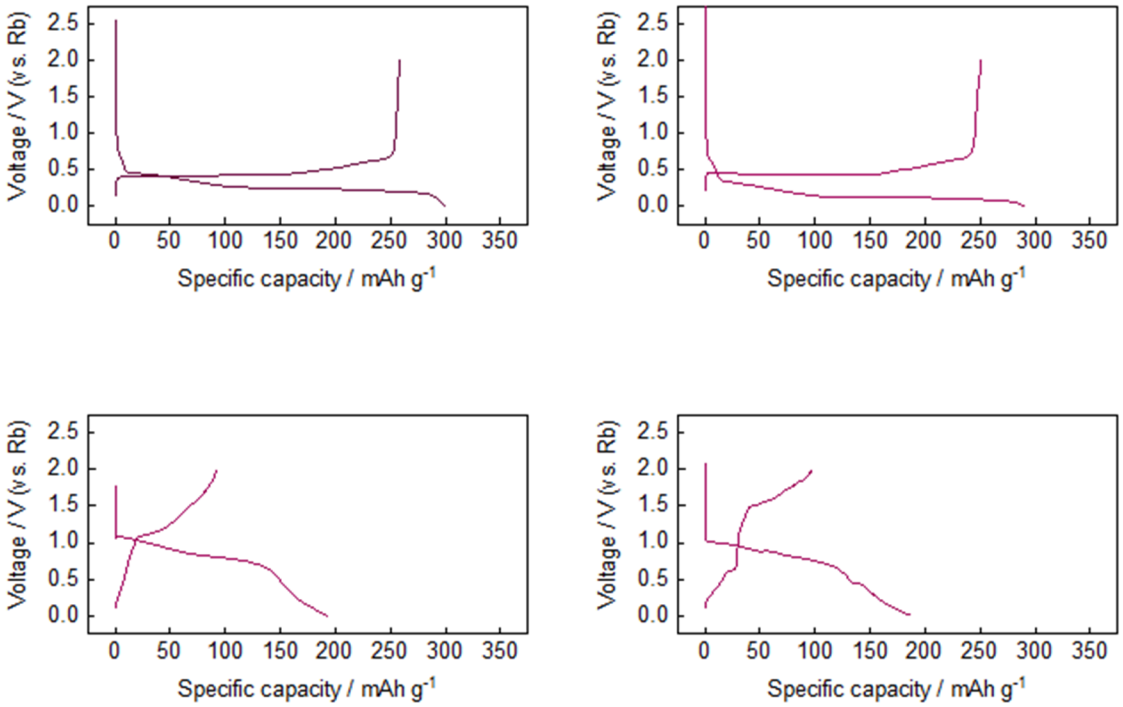

Fig. S12 Voltage–capacity curves of graphite // Rb cells in (a) [Rb(G3)][TFSA] (= 5.6 mol kg^{-1} RbTFSA/G3), (b) [Rb(G4)][TFSA] (= 4.5 mol kg^{-1} RbTFSA/G4), (c) 1 mol kg^{-1} RbTFSA/G3, (d) 1 mol kg^{-1} RbTFSA/G4.

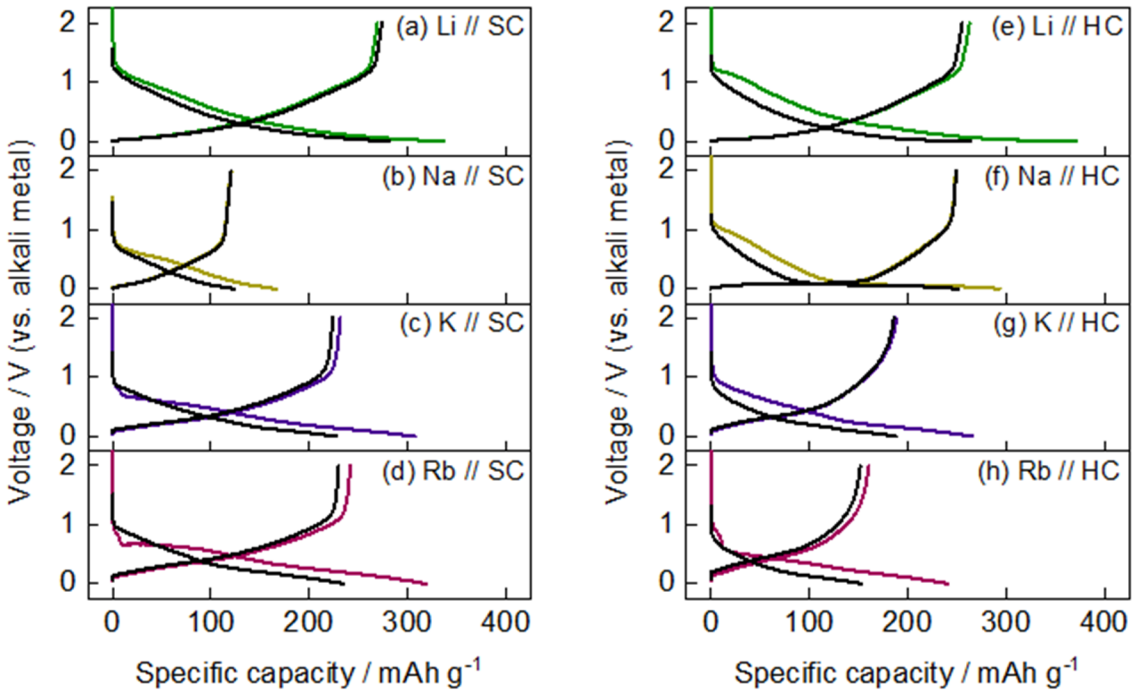

Fig. S13 Galvanostatic reduction–oxidation curves of (a) Li // SC, (b) Na // SC, (c) K // SC, (d) Rb // SC, (e) Li // HC, (f) Na // HC, (g) K // HC, and (h) Rb // HC cells. 1st and 2nd cycles are indicated by colored and black lines, respectively.