

**Supplementary information:**

**Constructing metal-anode rechargeable batteries utilizing concomitant  
intercalation of Li-Mg dual cations into Mo<sub>6</sub>S<sub>8</sub>**

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## X-ray diffraction (XRD) results

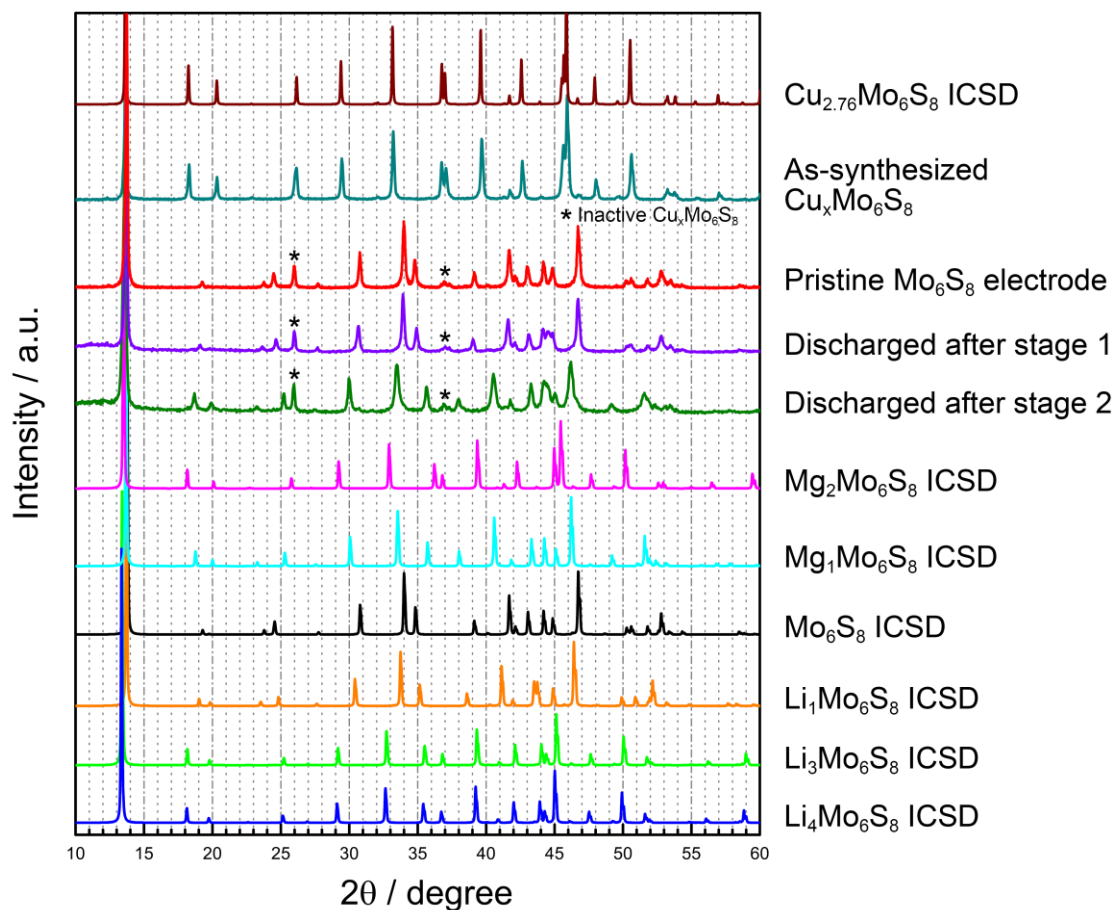


Fig. S1 XRD profiles of  $\text{Mo}_6\text{S}_8$  electrodes were measured after discharging in 0.5 M  $\text{Li}(\text{TFSA})$ -0.5 M  $\text{Mg}(\text{TFSA})_2/\text{G3}$ . The XRD profiles labeled “Discharged after stage 1” and “Discharged after stage 2” correspond to the ICP results shown in Fig. 4.

## Energy dispersive X-ray spectrometry (EDX) analysis

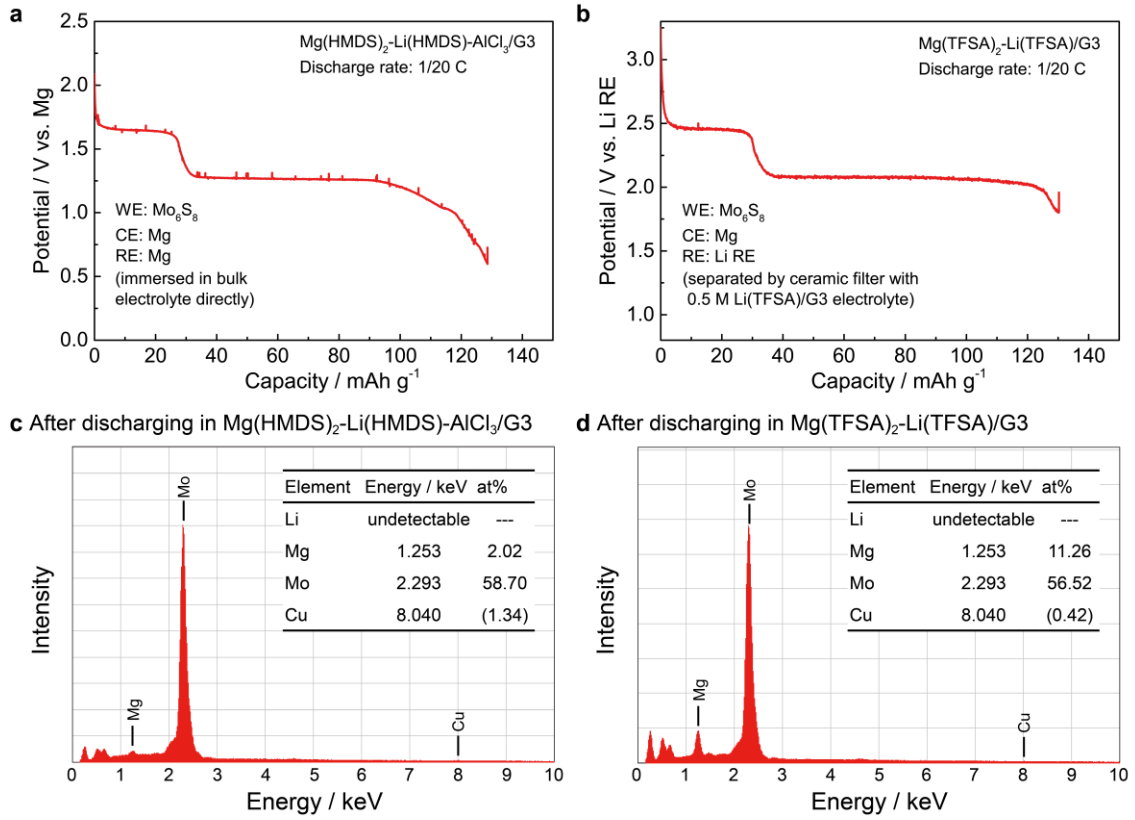


Fig. S2 EDX results for Mo<sub>6</sub>S<sub>8</sub> electrodes discharged in (a) 0.5 M Li(HMDS)-0.5 M Mg(HMDS)<sub>2</sub>-0.5 M AlCl<sub>3</sub>/G3 electrolyte and (b) 0.5 M Li(TFSA)-0.5 M Mg(TFSA)<sub>2</sub>/G3 electrolyte are shown in (c) and (d), respectively. In the inset tables, the Cu element is also included as a reference, but actually Cu was not detected in the EDX analysis.