Electronic Supplementary Material (ESI) for Materials Advances.

Supporting Information for:

Remarkable Ion Transport and Electrochemical Characteristics of Magnesium Fluorinated Alkoxyaluminate-Diglyme Electrolytes for Rechargeable Magnesium Batteries

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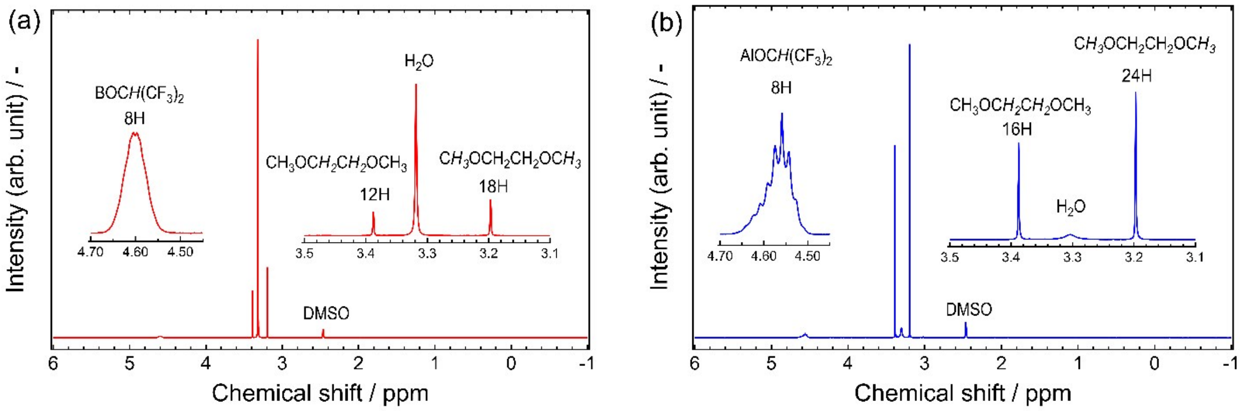

Figure S1. ^{1}H NMR spectra of (a) Mg[B(HFIP)$_4$]$_2$ and (b) Mg[Al(HFIP)$_4$]$_2$. The spectrum data of Mg[B(HFIP)$_4$]$_2$ was transcribed from Ref. 32 of the main text.

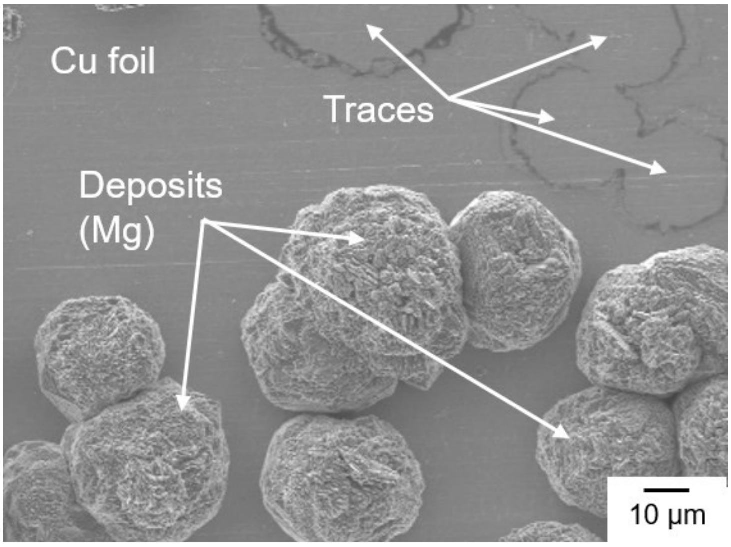

Figure S2. SEM image of Cu working electrode after galvanostatic polarization at 1 mA cm^{-2} for 1 h in 0.3 mol dm^{-3} Mg[Al(HFIP)$_4$]$_2$/G2 at 30 °C.

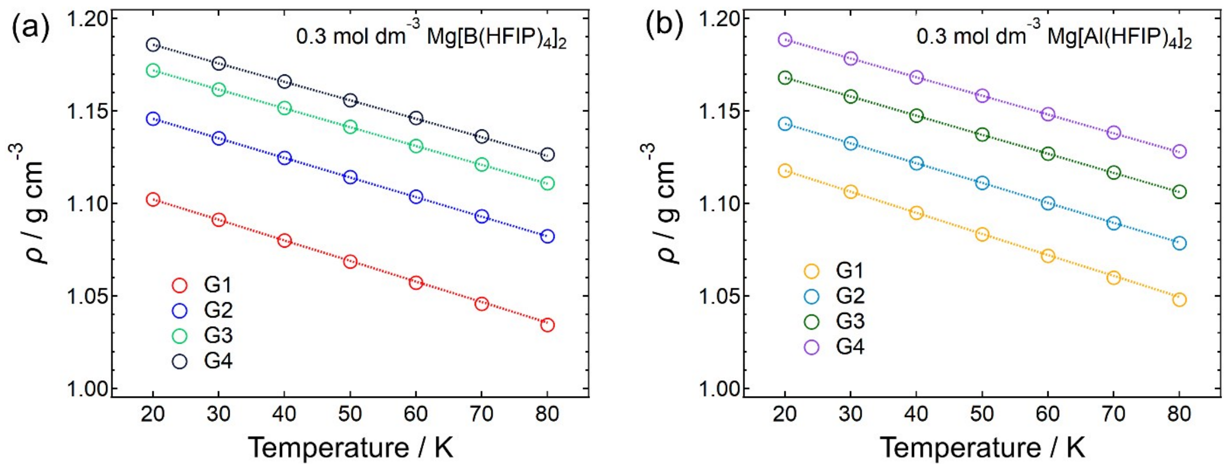

Figure S3. Liquid densities of 0.3 mol dm^{-3} (a) Mg[B(HFIP)$_4$]$_2$/G*n* and (b) Mg[Al(HFIP)$_4$]$_2$/G*n* (*n* = 1–4) measured in the temperature range of 20–80 °C. Based on the deviation from the slope made using the density-temperature profiles at the lower temperatures, the appropriate temperature range capable to characterize the transport properties was adopted.

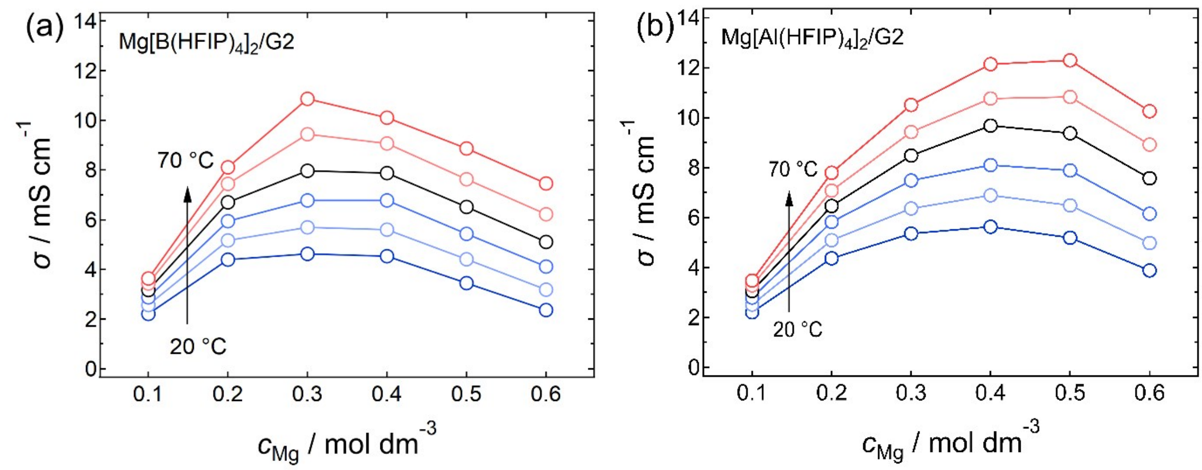

Figure S4. Ionic conductivities of (a) Mg[B(HFIP)$_4$]$_2$/G2 and (b) Mg[Al(HFIP)$_4$]$_2$/G2 measured in the temperature range of 20–70 °C.

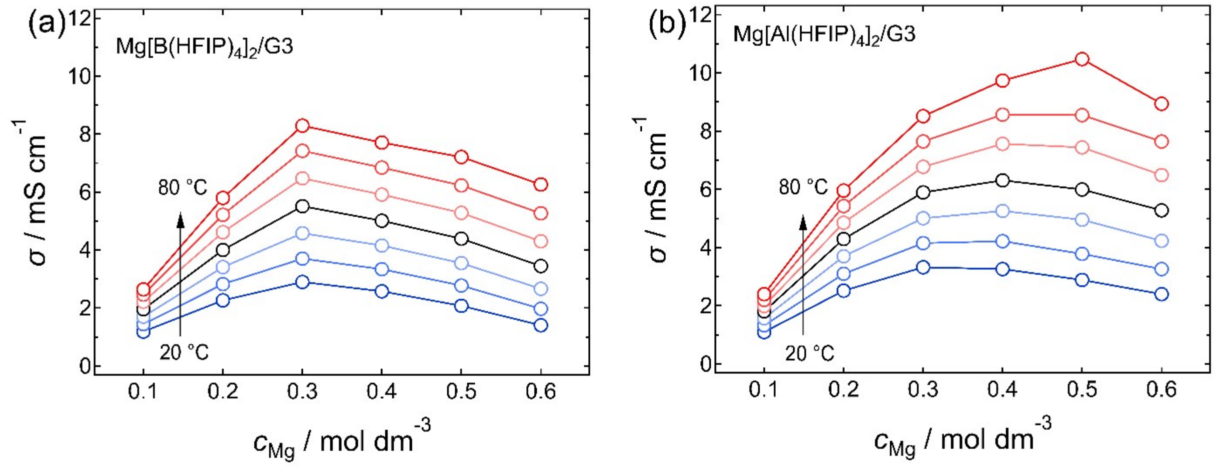

Figure S5. Ionic conductivities of (a) $Mg[B(HFIP)_4]_2$/G3 and (b) $Mg[Al(HFIP)_4]_2$/G3 measured in the temperature range of 20–70 °C.

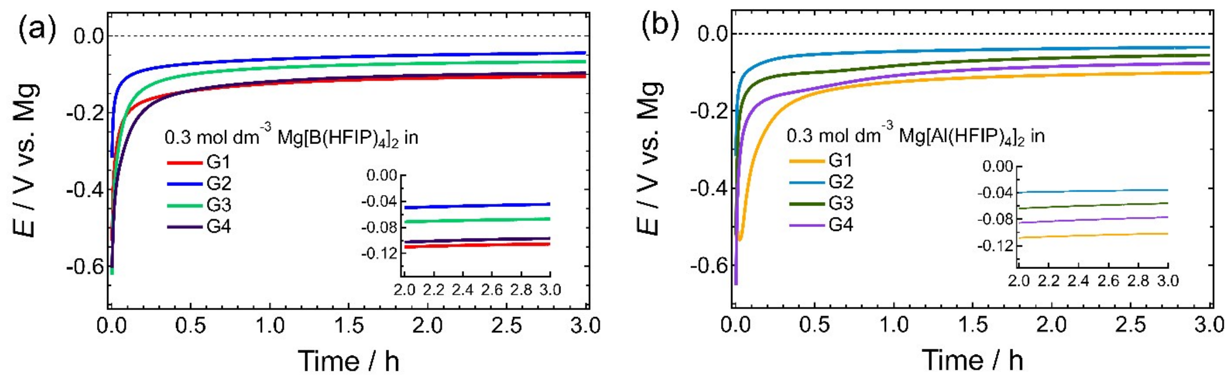

Figure S6. Voltage profiles of galvanostatic polarization in (a) 0.3 mol dm^{-3} $Mg[B(HFIP)_4]_2$/Gn and (b) 0.3 mol dm^{-3} $Mg[Al(HFIP)_4]_2$/Gn (n = 1–4) recorded on carbon fiber electrodes at 1 mA cm^{-2} at 30 °C. Insets display the magnified profiles of the steady state.

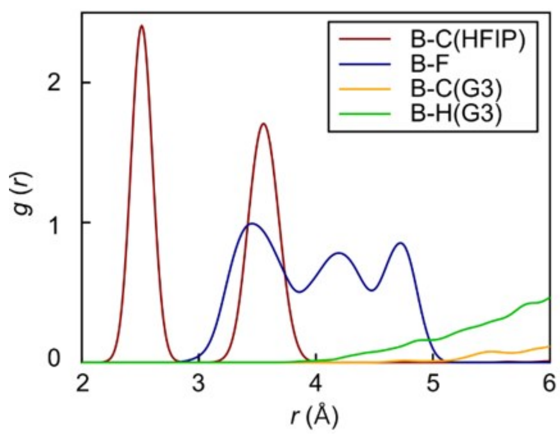

Figure S7. Calculated RDF profiles of (left) B and (right) Al surroundings in 0.3 mol dm^{-3} Mg[Z(HFIP)$_4$]$_2$/G3.

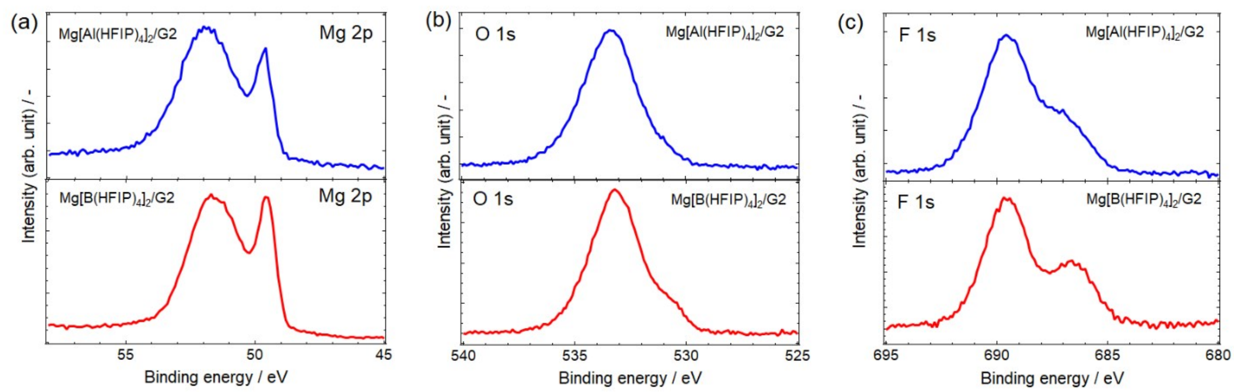

Figure S8. (a) Mg 2p, (b) O 1s, and (c) F 1s XPS spectra recorded on the magnesium metal deposited from 0.3 mol dm^{-3} Mg[Z(HFIP)$_4$]$_2$/G2 (Z = B or Al).

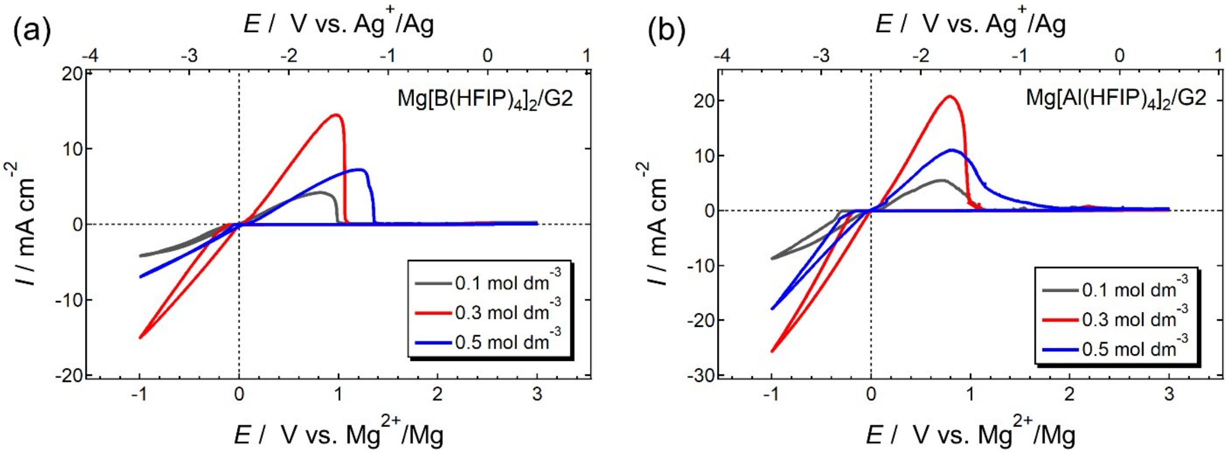

Figure S9. CVs of 0.1, 0.3, 0.5 mol dm^{-3} Mg[Z(HFIP)$_4$]$_2$/G2 (Z = B or Al) recorded on Pt electrode at a scan rate of 10 mV s^{-1} at 30 °C.

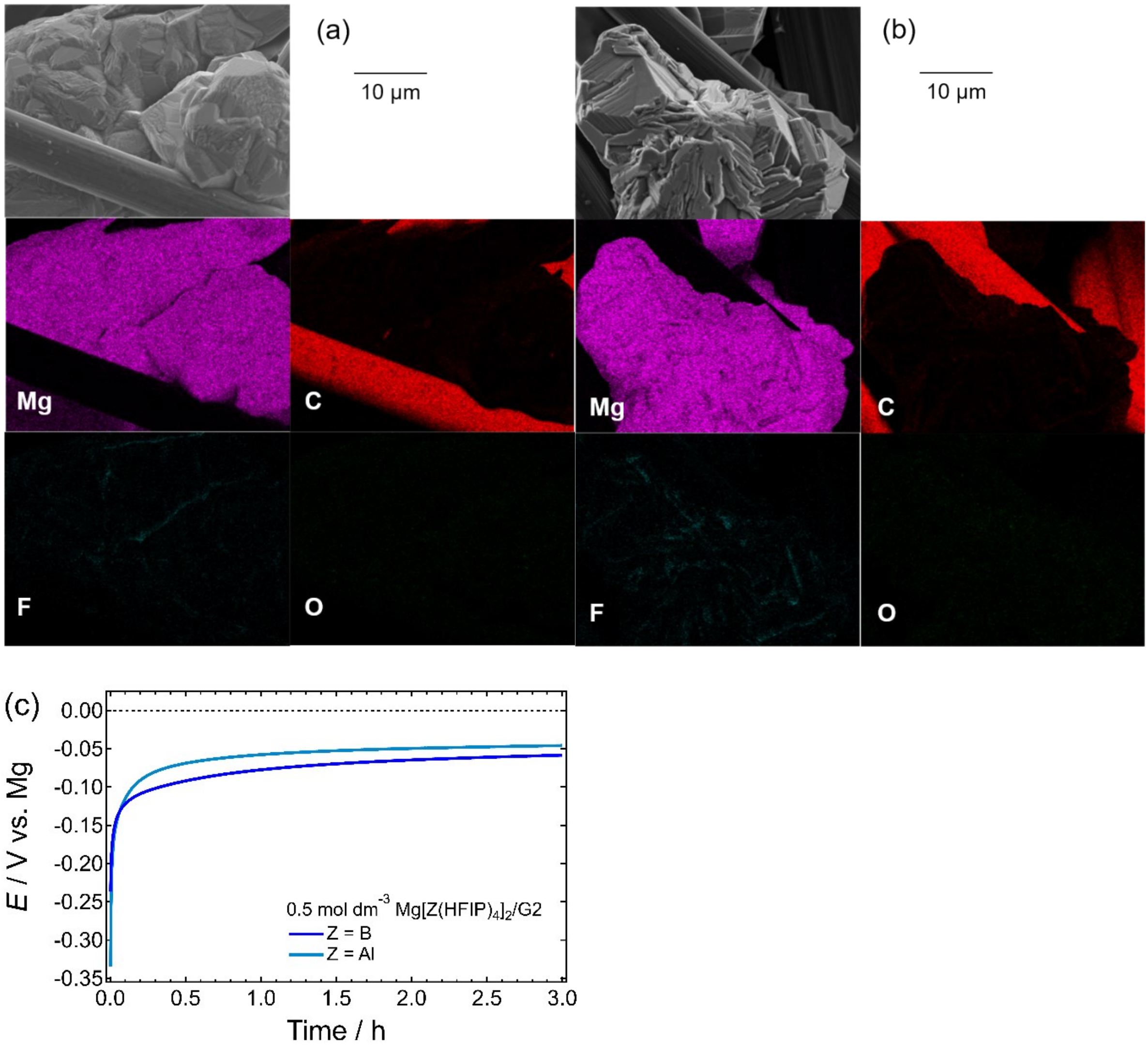

Figure S10. SEM images and corresponding EDX mapping of the electrodeposited magnesium obtained from (a) 0.5 mol dm^{-3} $Mg[B(HFIP)_4]_2$/G2 and (b) 0.5 mol dm^{-3} $Mg[Al(HFIP)_4]_2$/G2. (c) The corresponding voltage profiles of galvanostatic polarization recorded on carbon fiber substrates at 1 mA cm^{-2} at 30 °C were also included.

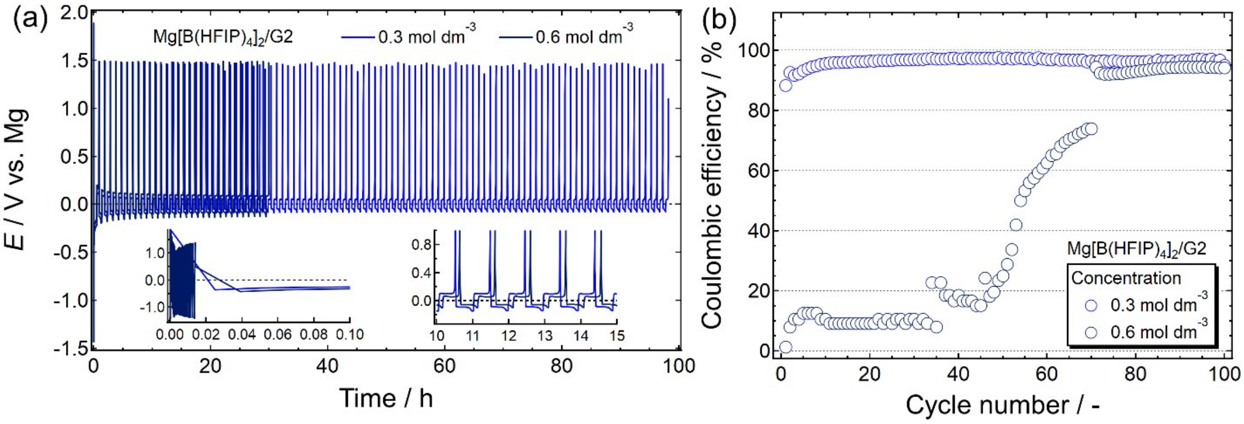

Figure S11. (a) Galvanostatic magnesium deposition/dissolution cycling profiles and (b) corresponding Coulombic efficiency in 0.3 and 0.6 mol dm^{-3} $Mg[B(HFIP)_4]_2$/G2. The 0.6 mol dm^{-3} solution required over 60 times of pre-cycling to complete the conditioning of the electrolyte and/or [electrolyte | anode] interface.