

Supplemental Materials for: Effect of the Electrolyte Solvent on Redox Processes in Mg-S Batteries

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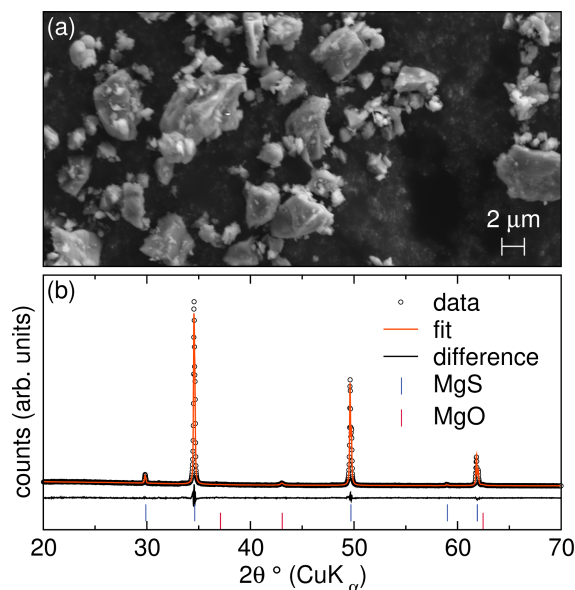


Figure S1: (a) SEM of the synthesized MgS. (b) Powder XRD of the as-prepared MgS used in the MgS electrodes. The two phase Rietveld refinement is shown along with the difference curve suggesting the material is mostly rock salt MgS with a 3.7% MgO impurity.

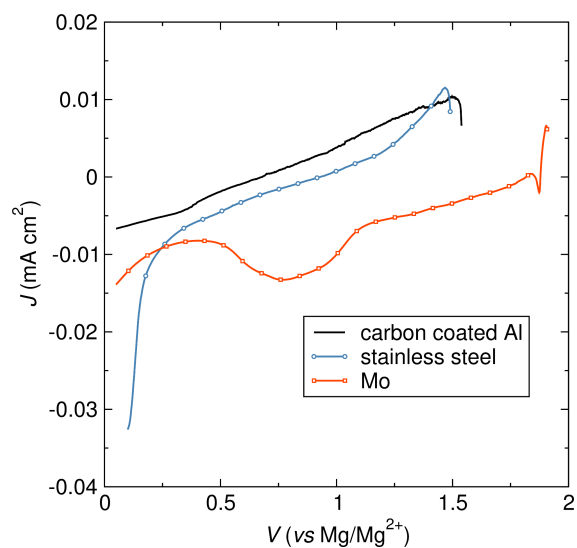


Figure S2: LSVs of Mg-C two-electrode cells with different current collectors. The electrolyte was 1xMACC in THF and the potential was swept negative at 0.05 mV s^{-1} . The least corrosion current was seen with a carbon coated Al current collector.

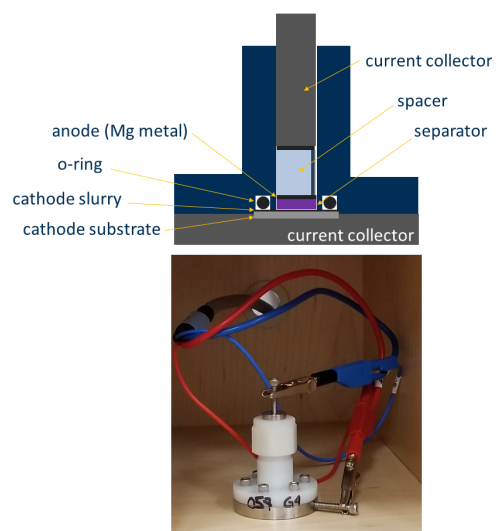


Figure S3: Custom cell designed to limit electrolyte contact with metal.

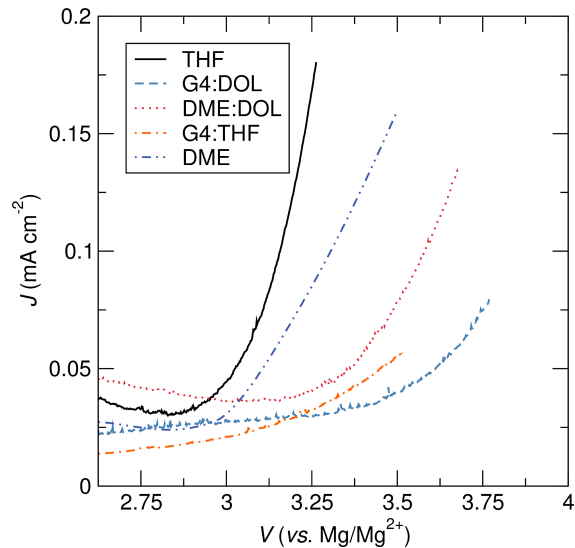


Figure S4: LSVs of the MACC electrolyte in different solvents. The traces demonstrate the anodic stability of the electrolyte on a Pt working electrode. The voltage was swept positive at 5.0 mV s^{-1} .

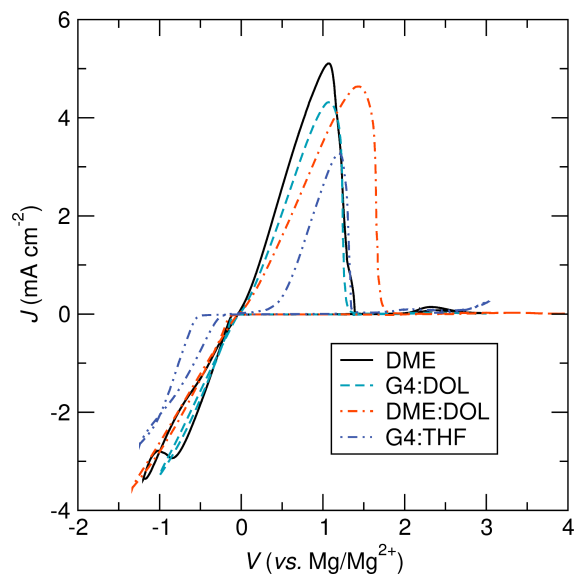


Figure S5: CVs of conditioned $0.3 \text{ M MgCl}_2 + 0.15 \text{ M AlCl}_3$ (5xMACC) in DME, G4:DOL, DME:DOL, and G4:THF. The CVs are measured in two-electrode cells with a Pt working electrode and Mg counter/reference electrode at 5 mV s^{-1} .

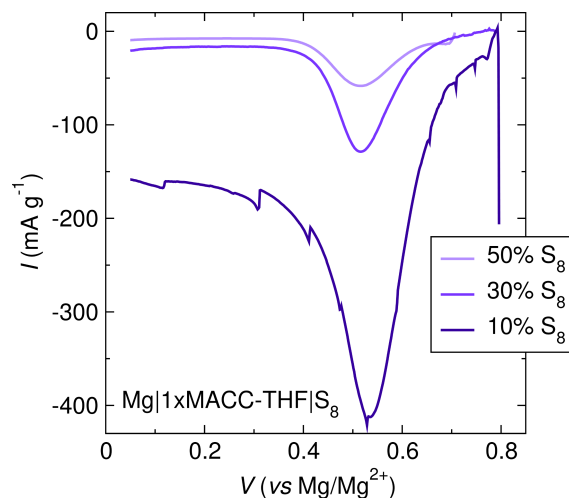


Figure S6: LSVs of Mg-S cells prepared with different concentrations of S_8 . The electrolyte was 1xMACC in THF and the potential was swept at 0.05 mV s^{-1} .

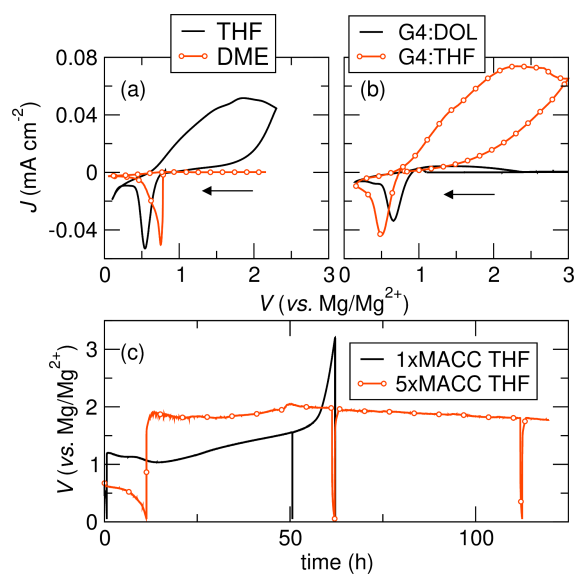


Figure S7: Full CVs of Mg-S cells with the 1xMACC electrolyte in (a) THF and DME and (b) G4:DOL and G4:THF solvents. The CVs are measured in two-electrode cells with a 50% S_8 working electrode and Mg counter/reference electrode at 0.05 mV s^{-1} . (c) Galvanostatic discharge and charging data for the Mg-S cell with the 1xMACC and 5xMACC electrolytes at $C/50$

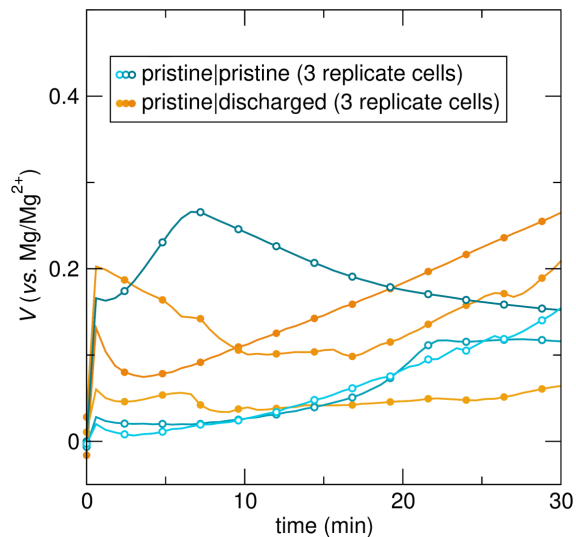


Figure S8: Galvanostatic oxidation of Mg|Mg symmetric cells with conditioned 1xMACC in THF electrolyte at 0.01 mA cm^{-2} . The counter electrode is a pristine Mg electrode in all cases. The working electrode is either a pristine Mg electrode or a Mg electrode extracted from a discharged Mg-S cell. Three replicate cells for each experiment are shown to demonstrate cell-to-cell variation.

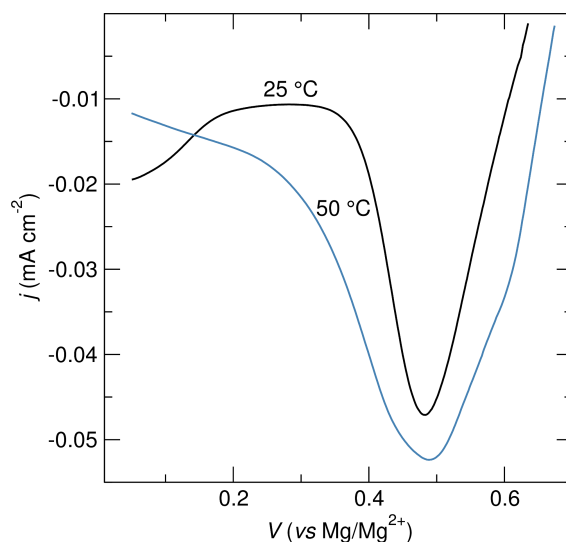


Figure S9: LSVs of Mg-S cells at $25 \text{ }^{\circ}\text{C}$ and $50 \text{ }^{\circ}\text{C}$. The scan rate was 0.05 mV s^{-1} , the cathode was 50% S, and the electrolyte was 1xMACC in THF.

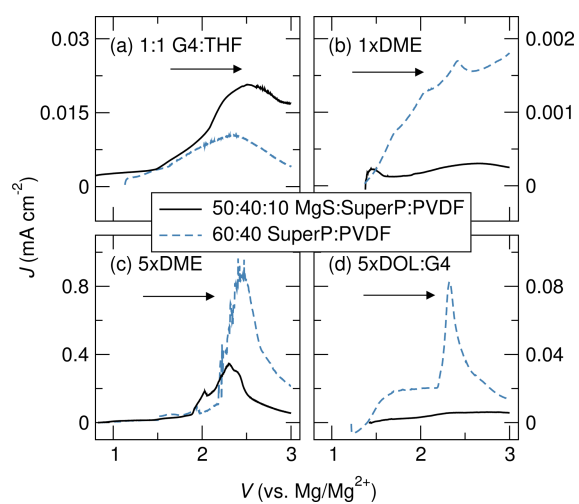


Figure S10: LSVs of Mg-MgS cells with the MACC electrolyte in various solvents. All cells were swept positive from OCV at 0.05 mV s⁻¹. The arrows indicate scanning direction.