

**Electrochemical Reactivity and Passivation of Organic Electrolytes at spinel MgCrMnO₄
Cathode Interface for Rechargeable High Voltage Magnesium-Ion Battery**

Zhenzhen Yang,^{a,b,*} Jiyu Cai,^a Evelyn Wang,^{a,b} Maksim Sultanov,^{c,d} Lihong Gao,^b Xianyang
Wu,^a Chen Liao,^{a,b} Zonghai Chen^a, Jianguo Wen,^c Lynn Trahey,^b Brian J. Ingram,^{a, b, *}

^a Chemical Sciences and Engineering Division, Argonne National Laboratory, Lemont,
Illinois, 60439, USA

^b Joint Center for Energy Storage Research, Lemont, Illinois, 60439, USA

^c Center for Nanoscale Materials, Argonne National Laboratory, Lemont, Illinois, 60439, USA

^d Department of Physics, Northern Illinois University, Dekalb, Illinois, 60115, USA

Corresponding authors: yangzhzh@anl.gov, ingram@anl.gov

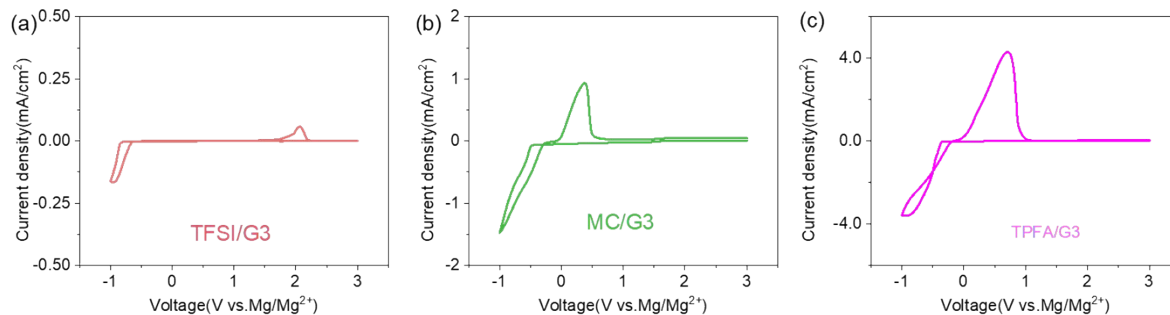


Figure S1. Cyclic voltammograms (CV) comparison for different anions in G3 of 0.1 M electrolytes (a): TFSI, (b) TPFA, (c) MC. Note different current scales are used to make the comparisons easier for the readers.

electrolyte	TFSI/G3	TPFA/G3	MC/G3	TPFA/G2	TPFA/MPA
Coulombic efficiency (%)	23	87	74	80	73
Plating potential (V)	-0.80	-0.35	-0.46	-0.34	-0.38
Stripping potential (V)	1.48	-0.10	-0.04	0.10	-0.03
Over-potential (V)	2.28	0.25	0.42	0.44	0.35

Table S1. Summarized Electrochemical properties from Figure 3a-b including CE, onset plating/stripping potentials, and overpotentials for each electrolyte at 0.1M.

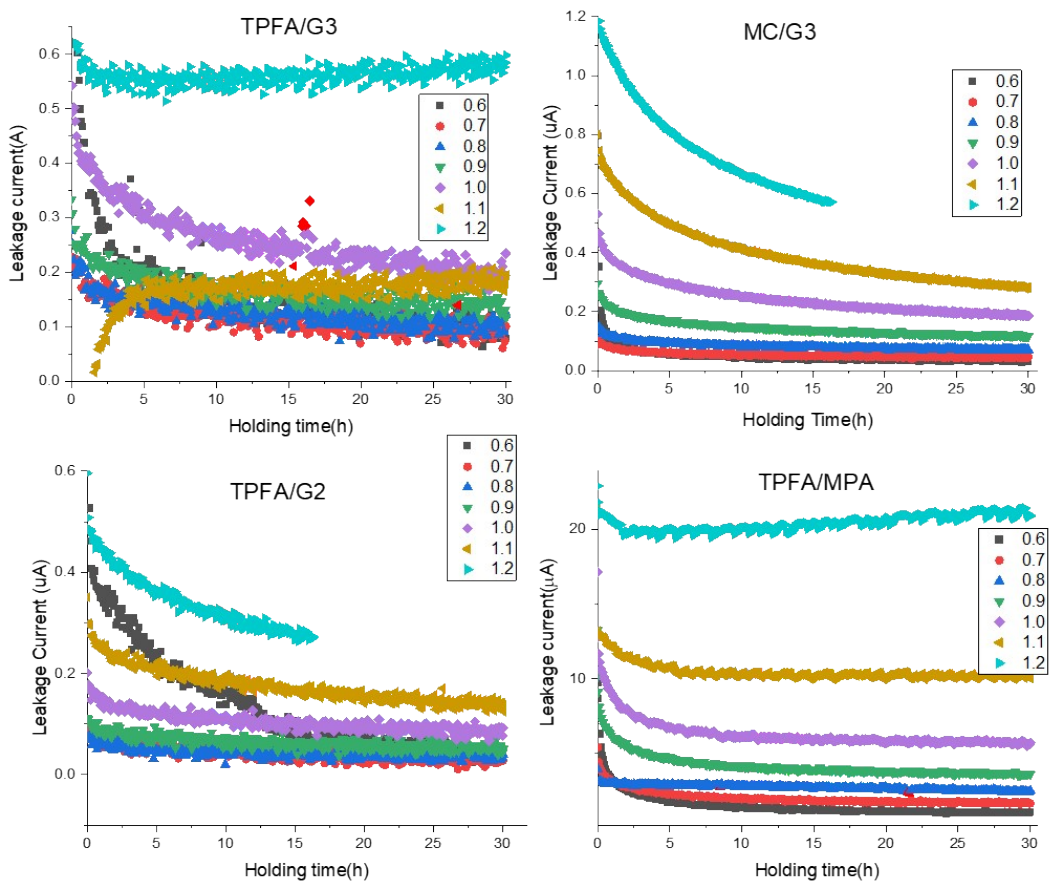


Figure S2. Dependence of the steady state leakage current on the working potential in half cells verse carbon cloth for TPFA/G3, MC/G3, TPFA/G2 and TPFA/MPA electrolyte.

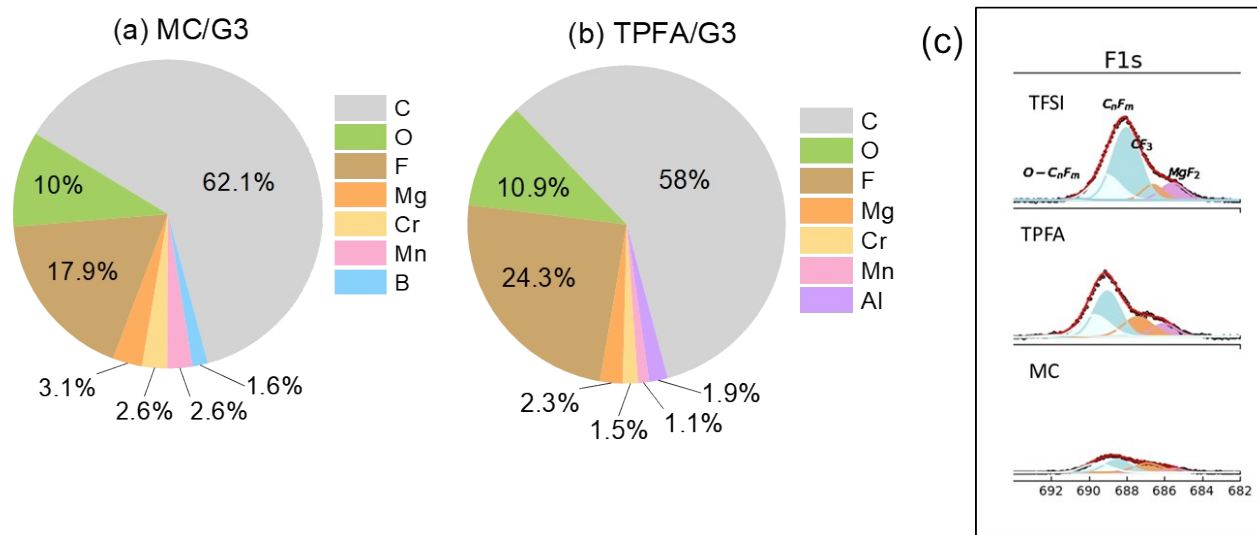


Figure S3. Atomic concentration of surface composition quantified by XPS in (a) MC/G3 and (b) TPFA/G3 and (c) F1s spectra in the inner layer of CEI after Ar⁺ sputtering.