Supplementary Information

Liquid Eutectic Gallium-Indium as a Magnesium-Ion Battery Anode with Ultralong Cycle Life Enabled by Liquid-Solid Phase Transformation During (De)Magnesiation at Room Temperature

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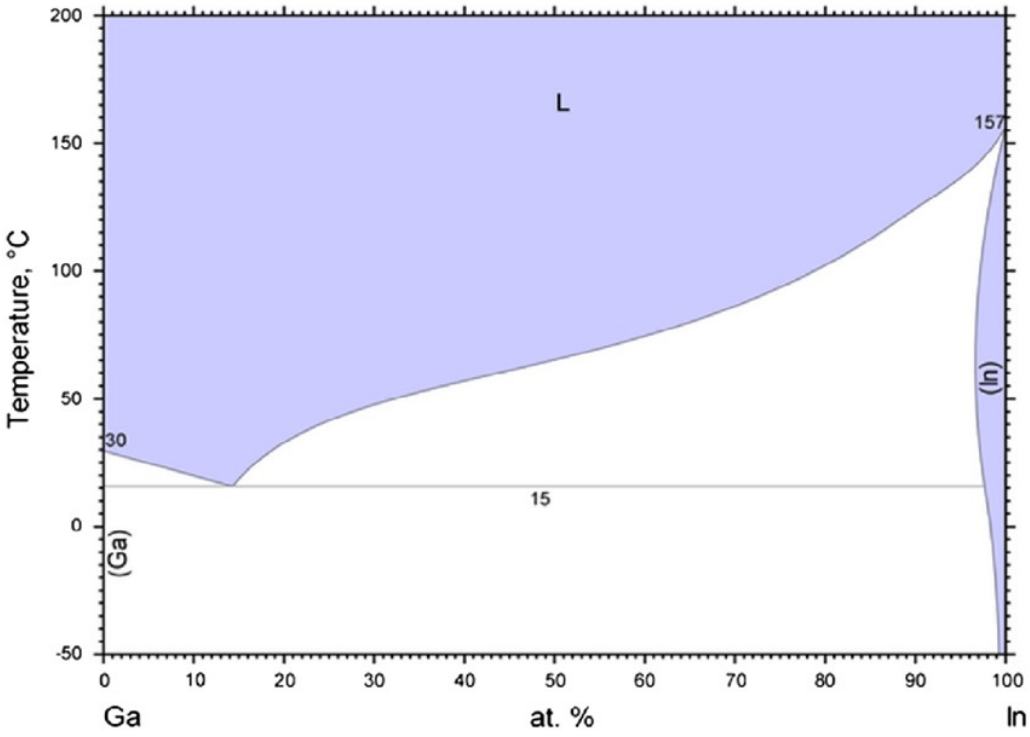


Figure S1. *Equilibrium phase diagram of the Ga-In system.* [22]

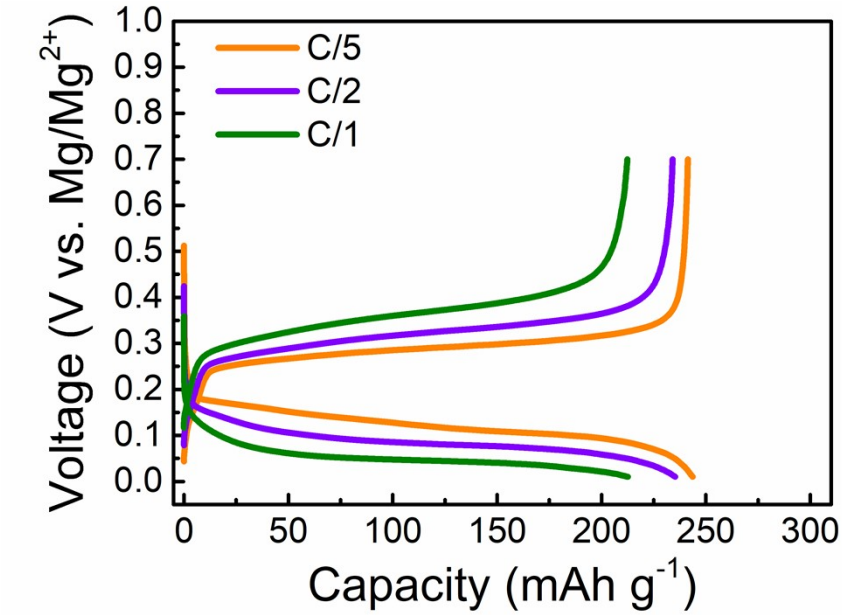
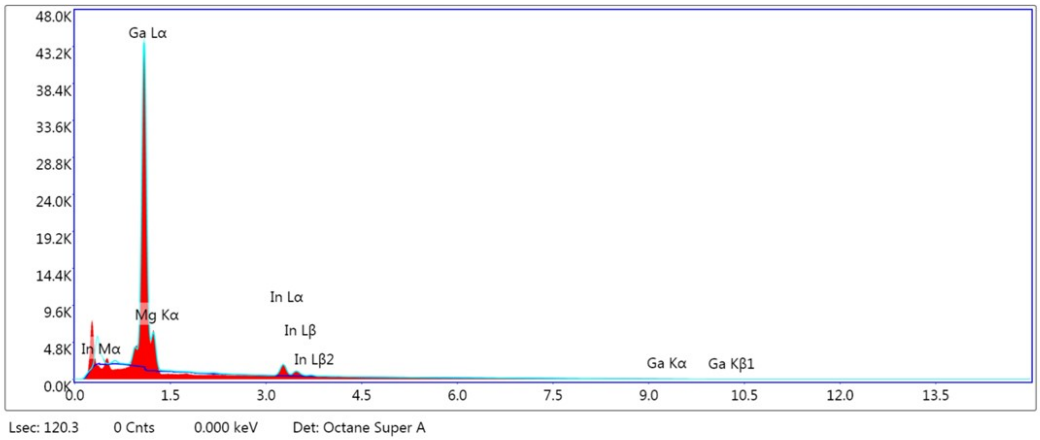


Figure S2. *Galvanostatic curves for (de)magnesiation at the rates of C/5, C/2, and 1 C at 25 °C. The shape of the curves is not affected by varying C-rates.*



Element	Weight %	Atomic %
Mg	9.59	24.90
Ga	71.42	64.66
In	18.99	10.44

Figure S3 *EDS spectrum of the Mg-Ga-In alloy.*

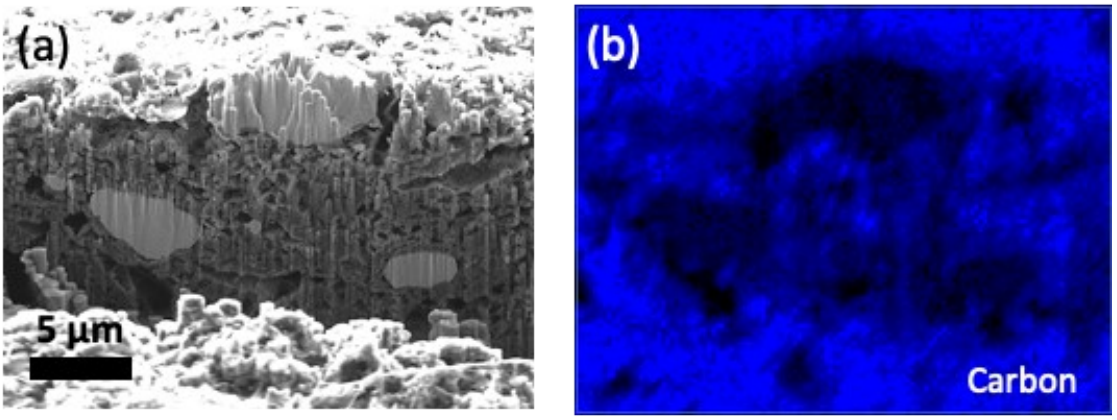


Figure S4 *(a) SEM image of a selected cross-section area in the demagnesiated EGaIn electrode after ion beam milling at 10 nA and ion polishing at 300 pA. (b) Corresponding EDS map of element carbon (dark blue).*

Table S1. Performance of common anode materials for magnesium ion batteries.

Anode Materials	C-rate or current density (mA g^{-1})	Capacity retained after cycling (mAh g^{-1})	Number of cycles	Working temperature (°C)	Ref.
Nanostructured Bi	C/1	303	200	RT	[1]
Bi nanorods@Nitrogen-doped mesoporous carbon matrix	100	320	100	RT	[2]
Bi nanowires	C/2	207	100	RT	[3]
Bi film	C/1	222	100	RT	[4]
Bi_xSb_{1-x}	C/1	215	100	RT	[5]
Bi/reduced graphene oxide nanocomposites	39	372	50	RT	[6]
Bi@carbon microrods	500	281	100	RT	[7]
$Pb_{0.7}Bi_{0.3}$/Bi film	200	172	250	RT	[4]
Bi_3Sn_2	1000	233	200	RT	[8]
InBi	C/20	100	280	RT	[9]
In	C/50	10	425	RT	[10]
Nanostructured SnSb	500	270	200	RT	[11]
Nanostructured Sn	450	180	150	RT	[12]
Sb film	C/1	16	50	RT	[5]
2D Black-TiO_{2-x} nanoflakes	300	106	400	RT	[13]
Graphite	C/10	22	100	RT	[14]
Li_3VO_4	20	171	15	RT	[15]
Spinel $Li_4Ti_5O_{12}$	300	50	500	RT	[16]
Pb	C/40	13	500	60 °C	[17]
$CuGa_2$-Ga	500	55	600	38°C	[18]

$CuGa_2$-GaSn	500	197	500	38 °C	[19]
GaSn film	100	75	250	24 °C	[20]
Ga	923	213	1000	40 °C	[21]
This work	**C/1**	**205**	**2000**	**25 °C**	

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