Electronic Supplementary Material (ESI) for Energy & Environmental Science

Supplementary Information

Ge inverse opal with porous wall as an anode for lithium ion batteries

Taeseup Song‡[1], Yeryung Jeon‡[2], Monica Samal[3], Hyungkyu Han[1], Hyunjung Park[2], Dong Kee Yi[3], Jae-Man Choi[4], Young-Min Choi[4] and Ungyu Paik[2*]

[1]*Department of Materials Science and Engineering, Hanyang University, Seoul 133-791, Korea*

[2]*WCU Department of Energy Engineering, Hanyang University, Seoul 133-791, Korea*

[3]*Division of Bionanotechnology, Gachon Bionano Institute, Gachon University, Geonggi-do 461-701, Korea*

[4]*Energy Lab, Samsung Advanced Institute of Technology, Samsung Electronics Co. Ltd., Suwon 440-600, Korea*

‡ Both authors contributed equally to this work.

Corresponding Author*

Ungyu Paik (upaik@hanyang.ac.kr)

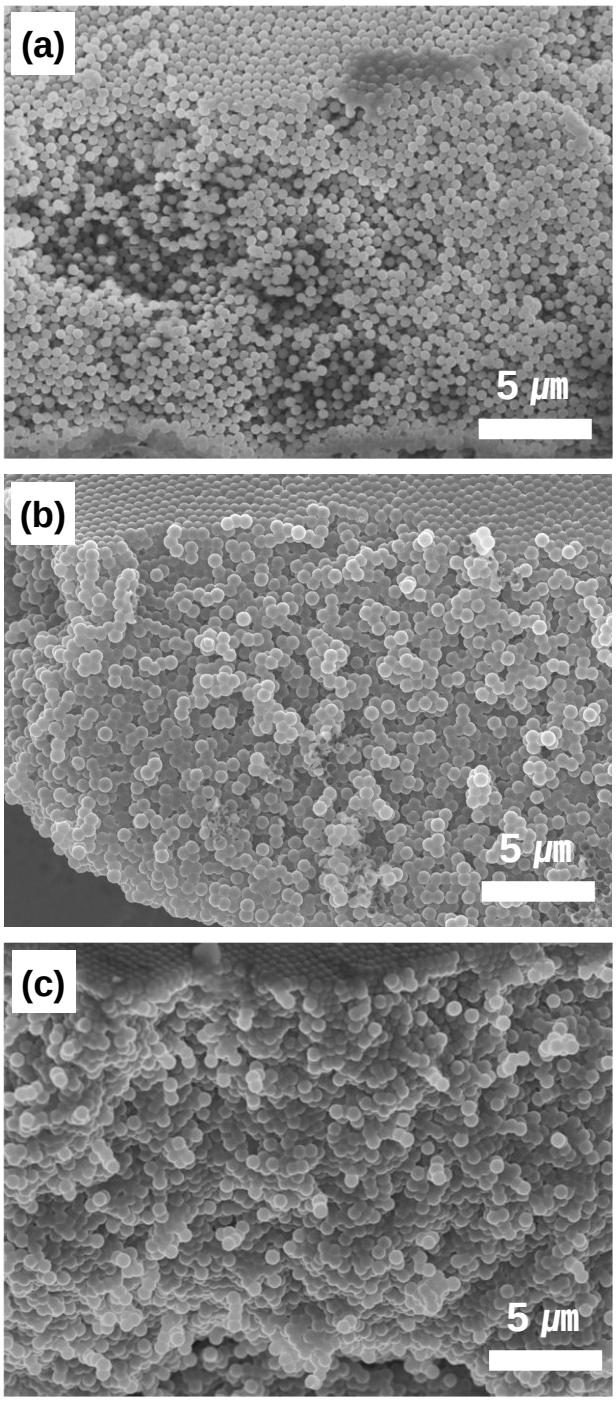

Figure S1. SEM images of silica opal template and Ge inverse opal with different wall microstructures. (a) 45° tilted SEM image of silica opal. (b) 45° tilted SEM image of Ge inverse opal with porous wall. (c) 45° tilted SEM image of Ge inverse opal with dense wall.

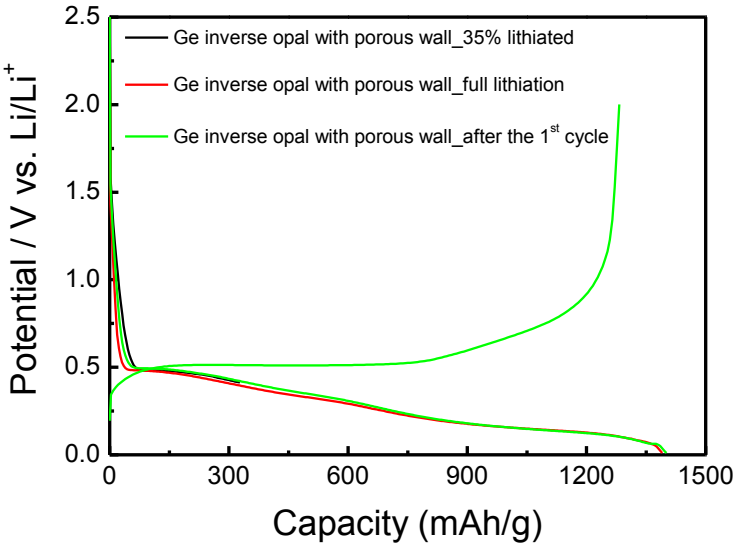

Figure S2. Voltage profiles of Ge inverse opal with porous wall electrode in a coin-type half cell after 35% lithiation and full lithiation of the first cycle and 1 cycle at a rate of 0.2C.

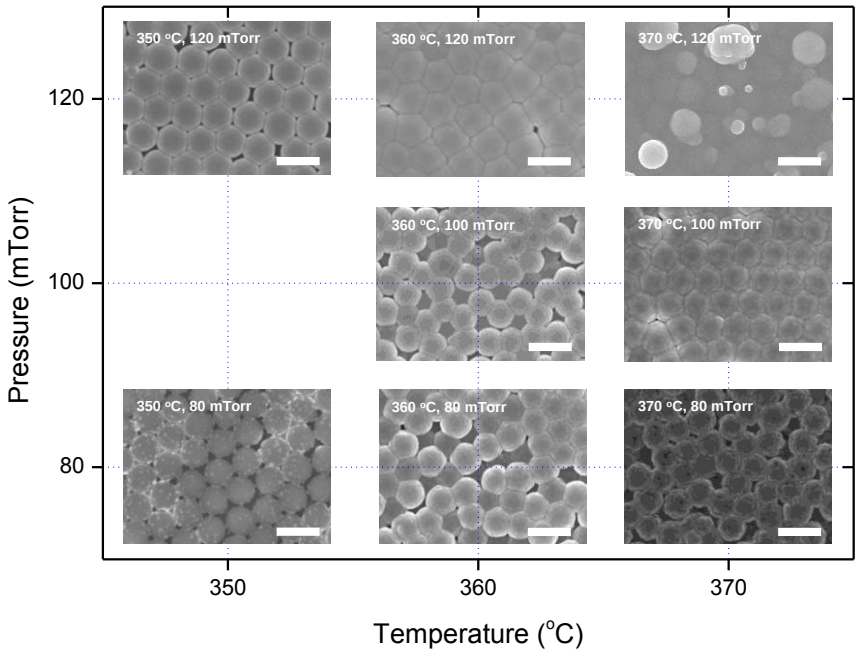

Figure S3. Morphological changes in Ge film on the silica opal as functions of the processing temperature and pressure. Scale bar is 1μm.

Table S1. The initial coulombic efficiencies and internal resistances of both the Ge inverse opal electrodes with dense wall and porous wall.

	The 1st coulombic efficiency	Internal resistance (Ω)							
		x (Li_xGe) during lithiation				x (Li_xGe) during delithiation			
Porous wall	93%	1.502 x 10^6	1.567 x 10^6	1.257 x 10^6	1.064 x 10^6	9.694 x 10^6	6.753 x 10^6	7.328 x 10^6	9.763 x 10^6
		x=0.539	x=1.482	x=2.291	x=2.965	x=3.459	x=2.785	x=1.976	x=1.166
Dense wall	93.6%	2.078 x 10^6	2.039 x 10^6	1.906 x 10^6	1.586 x 10^6	1.115 x 10^6	8.737 x 10^6	1.079 x 10^6	1.402 x 10^6
		x=0.539	x=1.482	X=2.291	x=2.965	x=3.495	x=2.822	x=2.013	x=1.204