Supplementary Information

Table S1. Theoretical electrochemical equivalents of selected metal-air materials

Material	Density (g/cm^3)	Electrochem. Equiv. (Ah/cm^3)	Energy Density (kWh/L)	Specific Energy (kWh/kg)
Carbon	2.27	20.26	20.67	9.1
Silicon	2.33	8.89	14.23	6.11
Germanium	5.32	7.85	7.85	1.48
Zinc	7.1	5.82	9.31	1.31
Lithium	0.53	2.05	6.96	13.13

Condition: 20 C and 1 atm

* Free Energy: $\Delta G^\circ = -nFE^\circ$

** Theoretical Capacity (Coulombic)

: Theoretically 1 gram-equivalent weight of material will deliver 96,487 C or 26.8 Ah (Faraday).

(A gram-equivalent weight is the atomic weight of the active material in grams divided by the number of electrons involved in the reaction.)

*** Based on active anode (fuel electrode) only (O_2 not included),

Reference:

Linden, TB Reddy, Handbook of Batteries, 4th ed., McGraw- Hill, New York, 2010

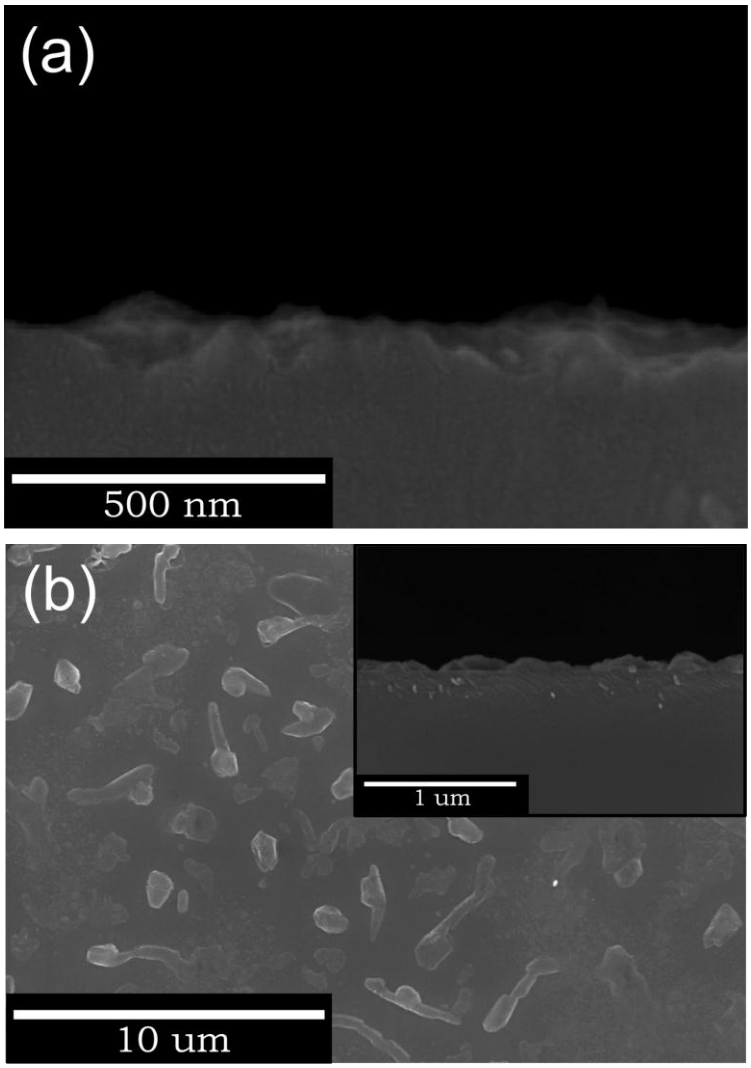

Fig. S1 (a) Cross-section SEM image of PGe showing non-uniform surface (40 wt. % HF, 1 mA/cm^2, 3 hr) and (b) Plain and cross-section SEM images of a highly electropolished Ge (5 wt. % HF, 100.0 mA/cm^2, 24 hr).

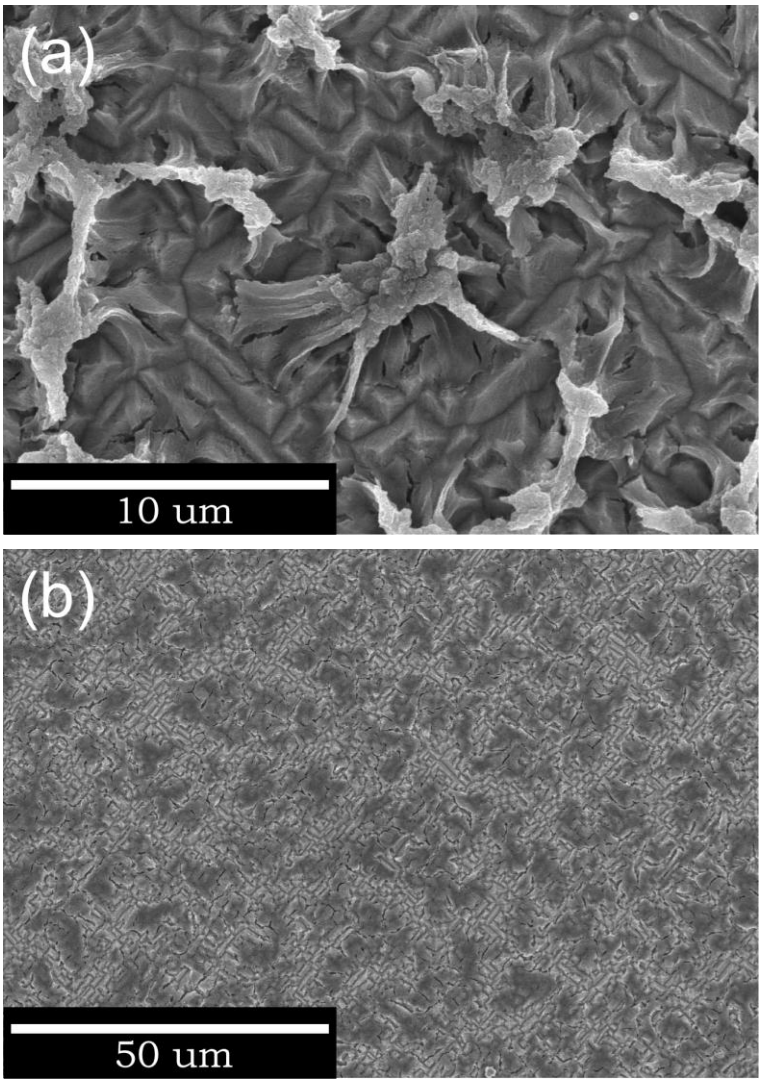

Fig. S2 SEM images of other porous Ge structures that can be formed in different etching conditions, (a) 48 wt. %, 0.5 mA/cm^2, 24 hr and (b) 40 wt. % HF, 0.5 mA/cm^2, 24 hr.

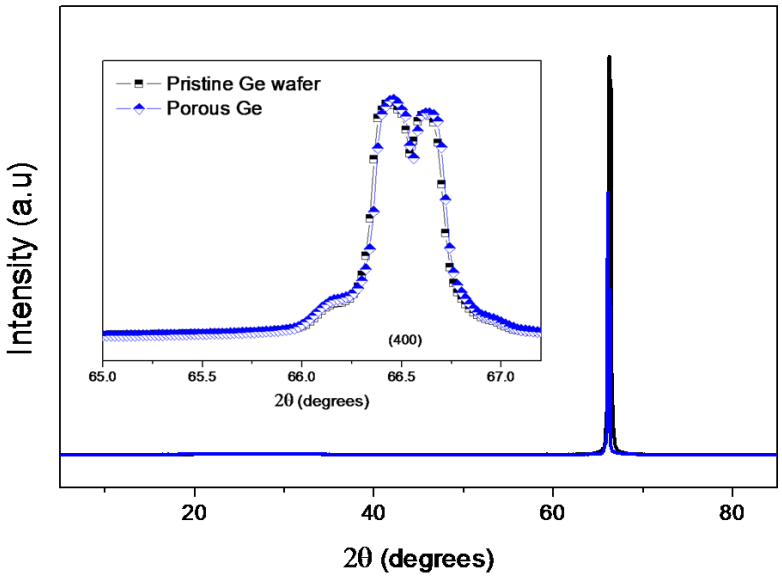

Fig. S3 X-ray diffractograms of pristine and etched Ge wafers.

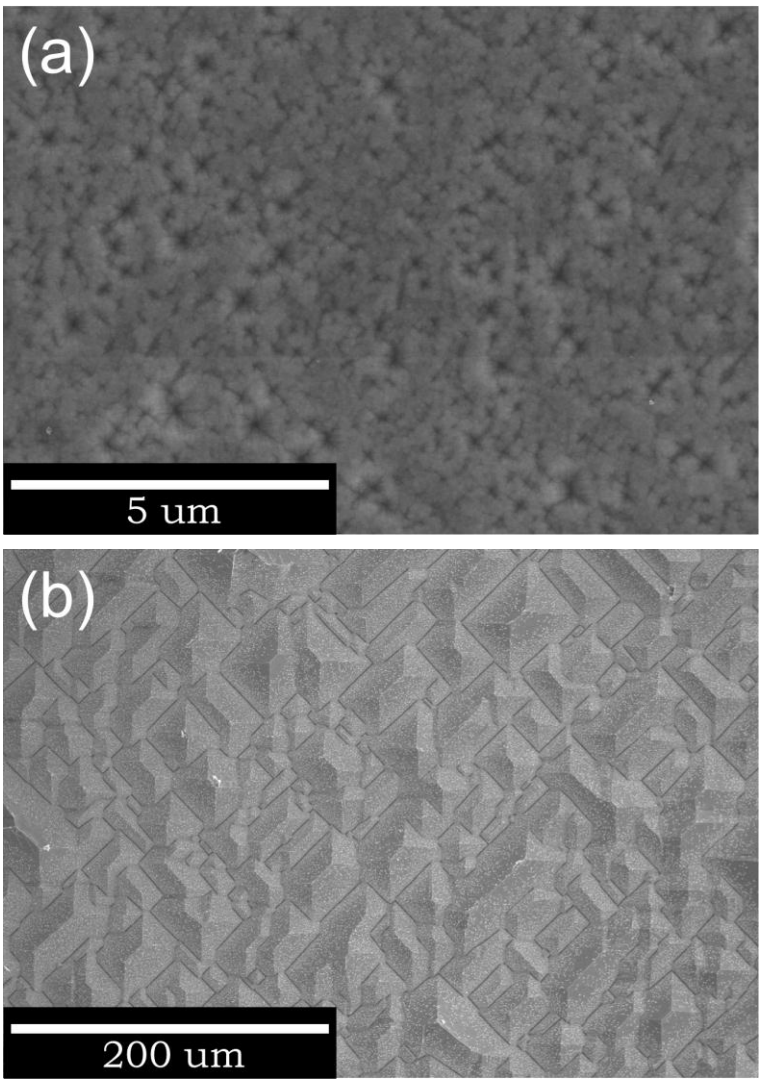

Fig. S4 Post-galvanostatic discharge SEM images of the ordered PGe structures, (a) EE-PGe and (b) EE-ELE-PGe

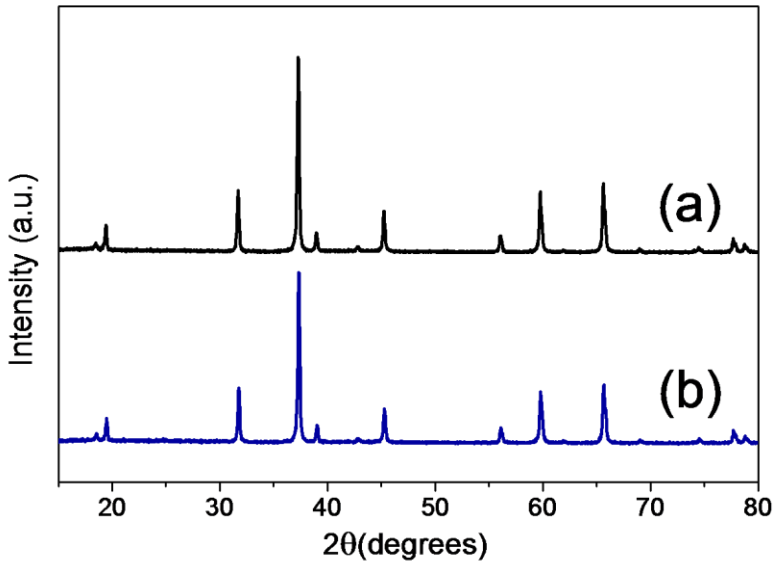

Fig. S5 X-ray diffractograms of the gas diffusion electrode used in the Ge-air cell (a) before and (b) after the discharge.