

**Supporting Information**

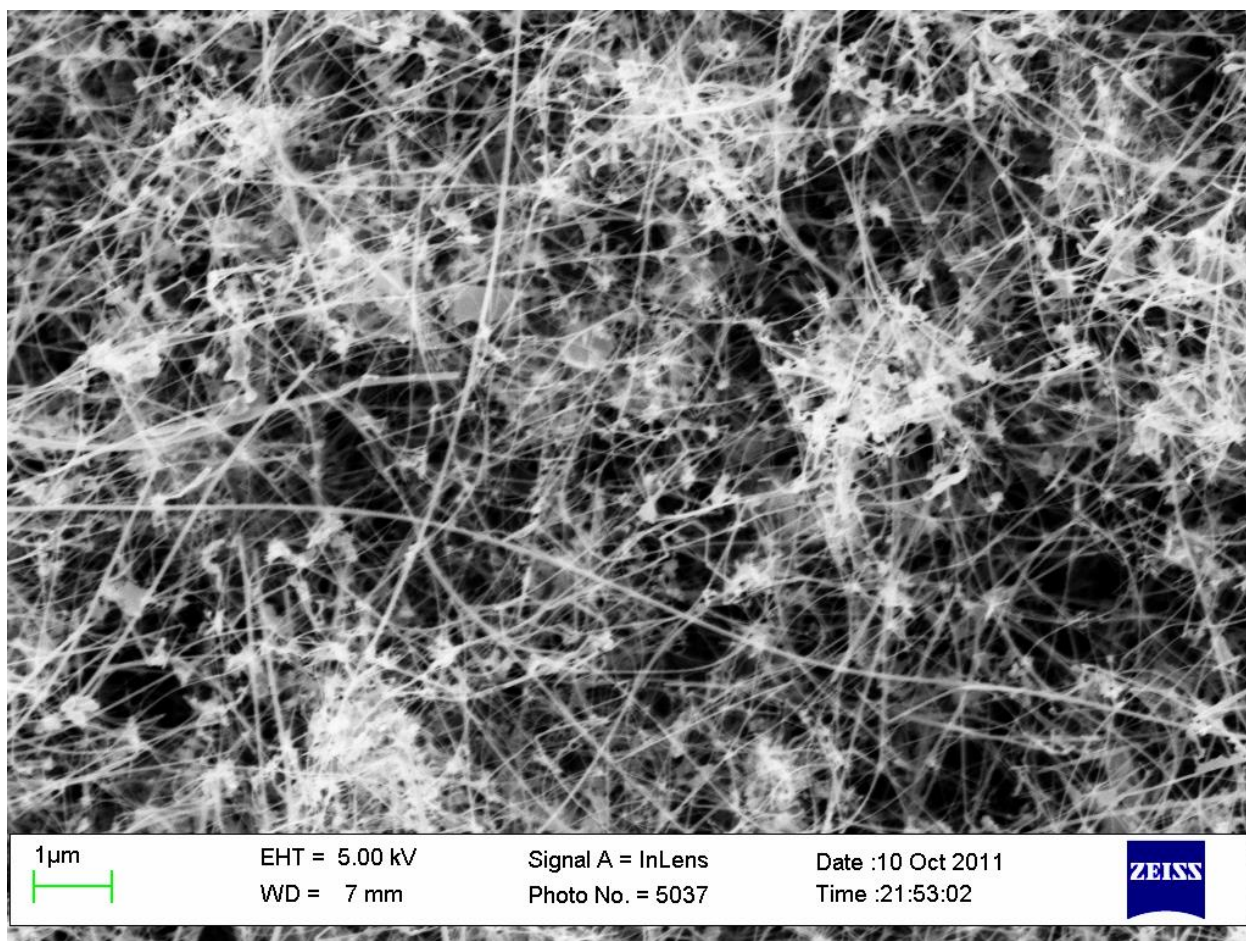
*Operando* X-Ray Scattering and Spectroscopic  
Analysis of Germanium Nanowire Anodes in  
Lithium-Ion Batteries

*Katharine E. Silberstein,<sup>†</sup> Michael A. Lowe,<sup>†</sup> Benjamin Richards,<sup>‡</sup> Jie Gao,<sup>†</sup> Tobias Hanrath,<sup>§</sup>  
and Héctor D. Abruña<sup>\*†</sup>*

<sup>†</sup>Department of Chemistry and Chemical Biology, <sup>‡</sup>Department of Materials Science and  
Engineering, and <sup>§</sup>School of Chemical and Biomolecular Engineering, Cornell University,  
Ithaca, New York 14853, United States

**Corresponding Author**

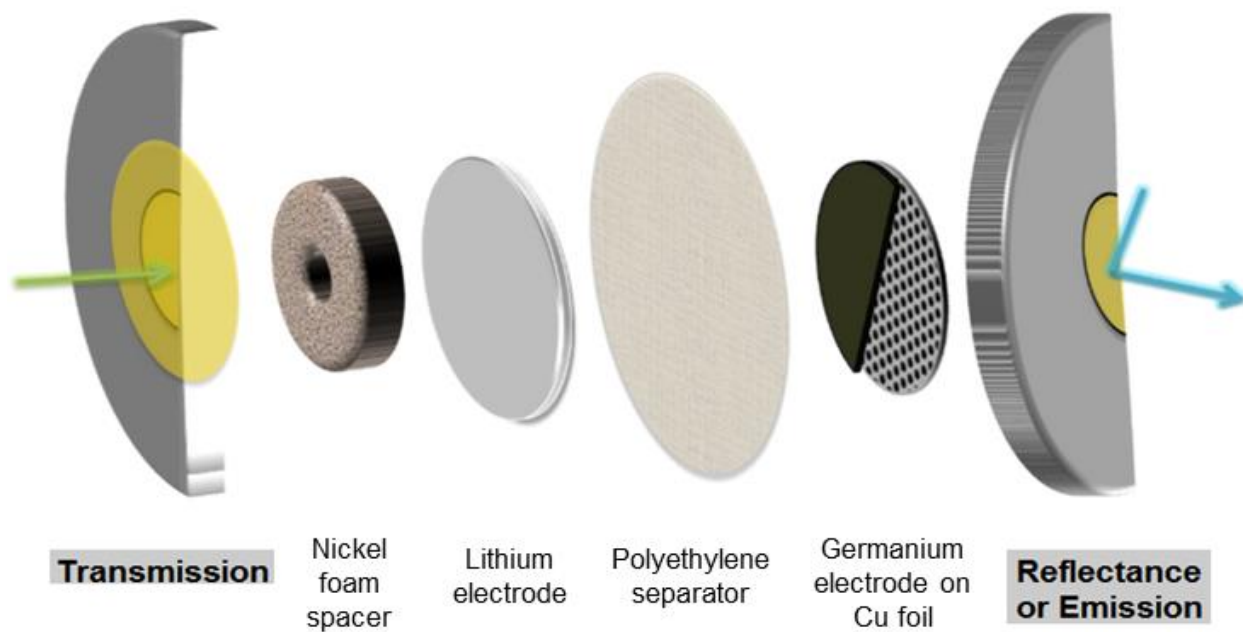
Tel.: 1-607-255-4720. Fax: 1-607-255-9864. \*Email: [hda1@cornell.edu](mailto:hda1@cornell.edu)



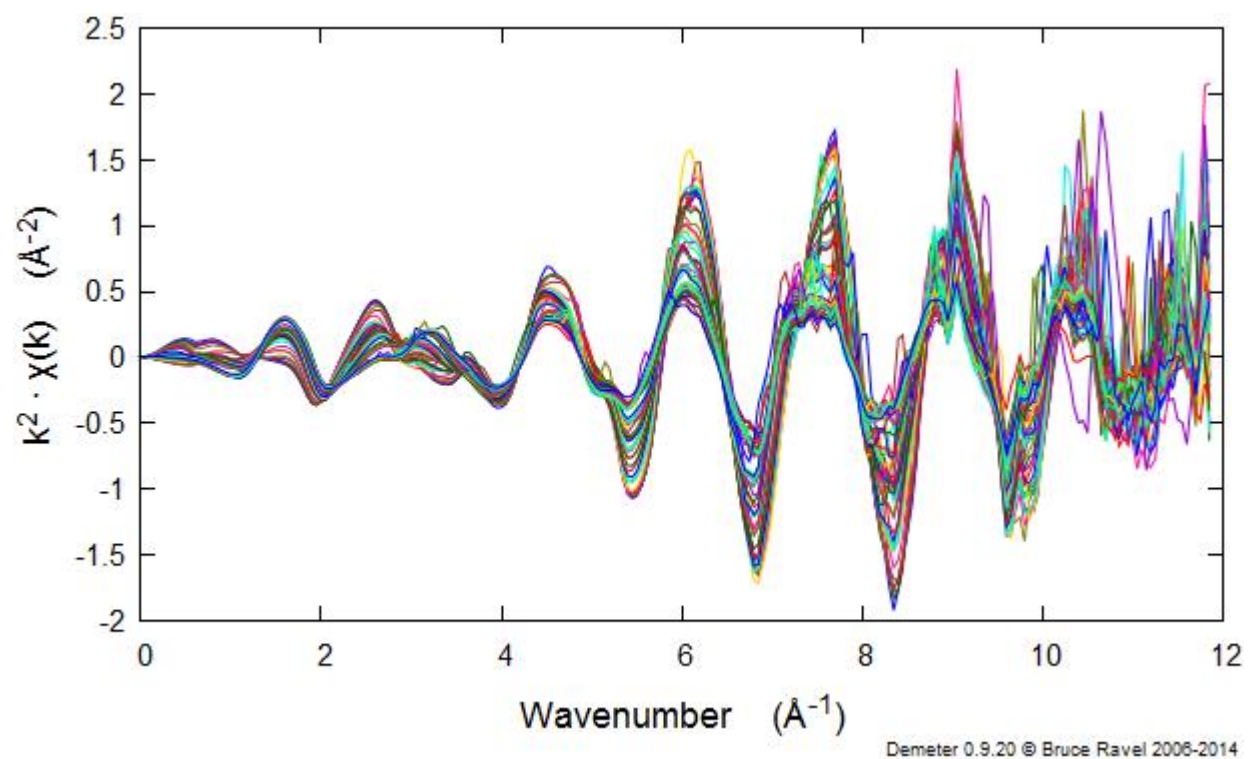
**Figure S1:** Scanning electron micrograph of as-prepared germanium nanowires.

Cell Dimensions: 20 mm diameter by 3.2 mm thickness; Kapton windows sealed by epoxy

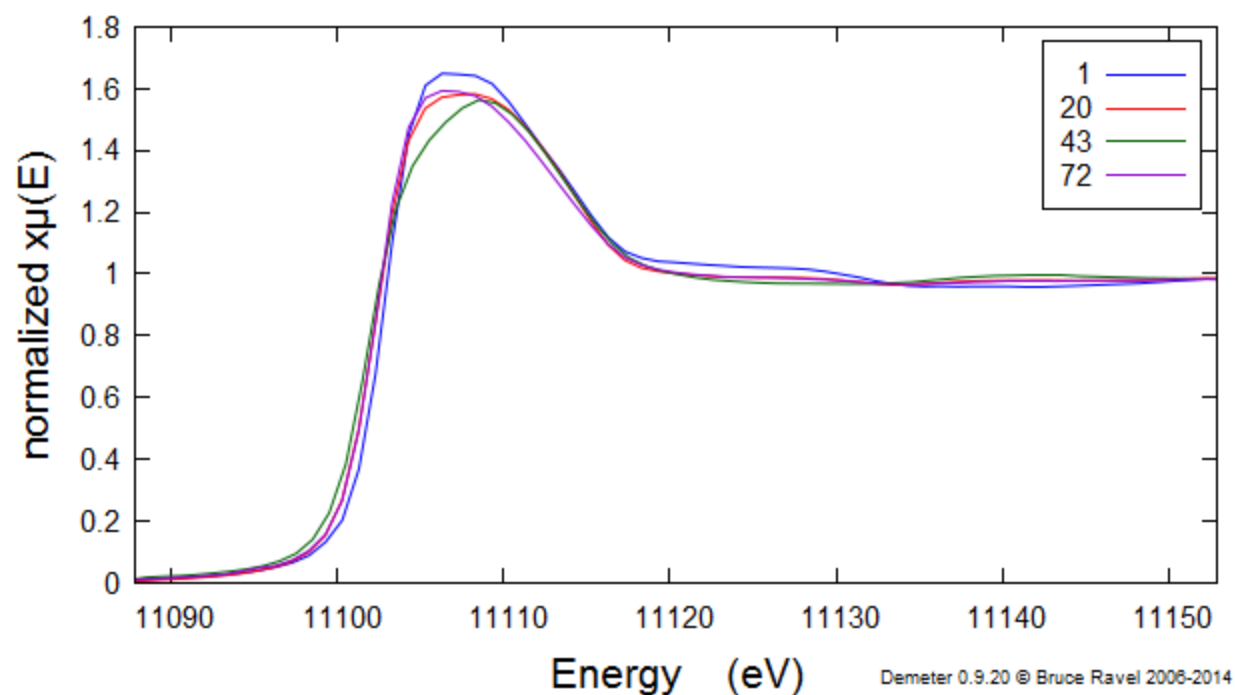
Solvent/Electrolyte system: 1:1 EC:DEC with 1 M  $\text{LiPF}_6$



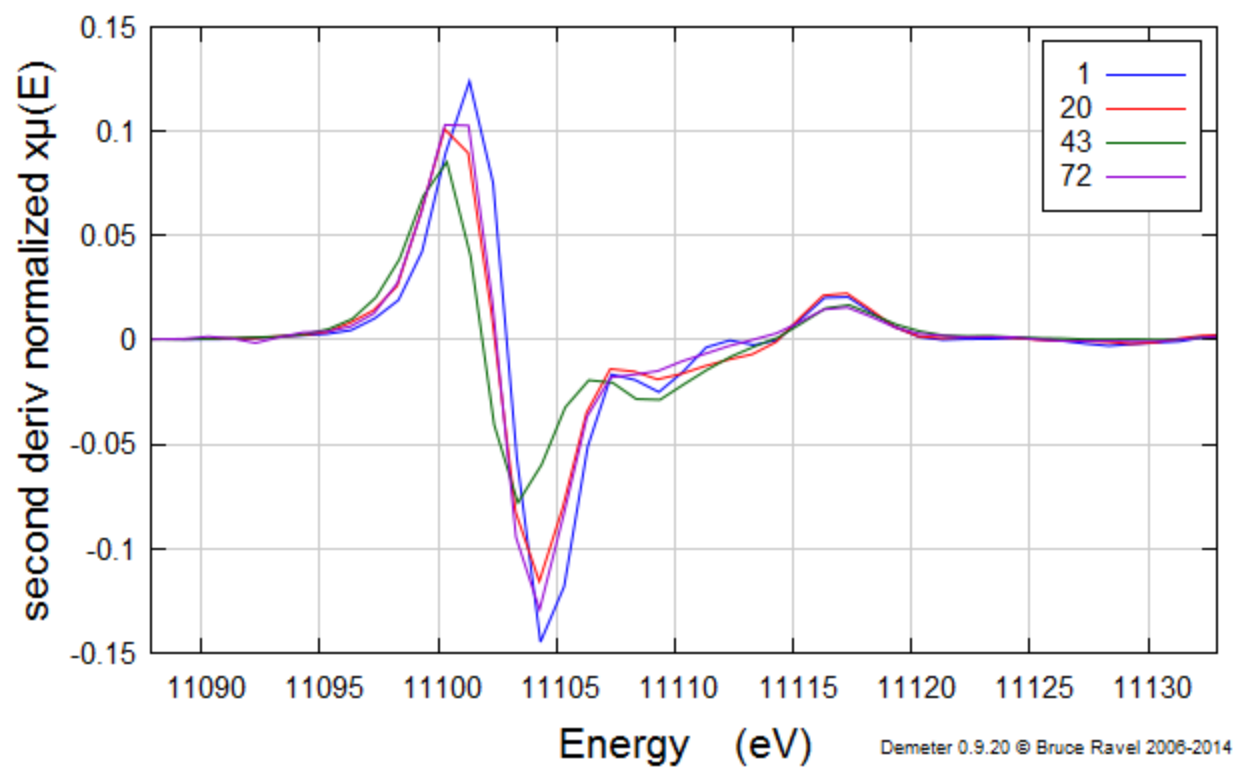
**Figure S2:** Exploded schematic of the *operando* coin cell setup.



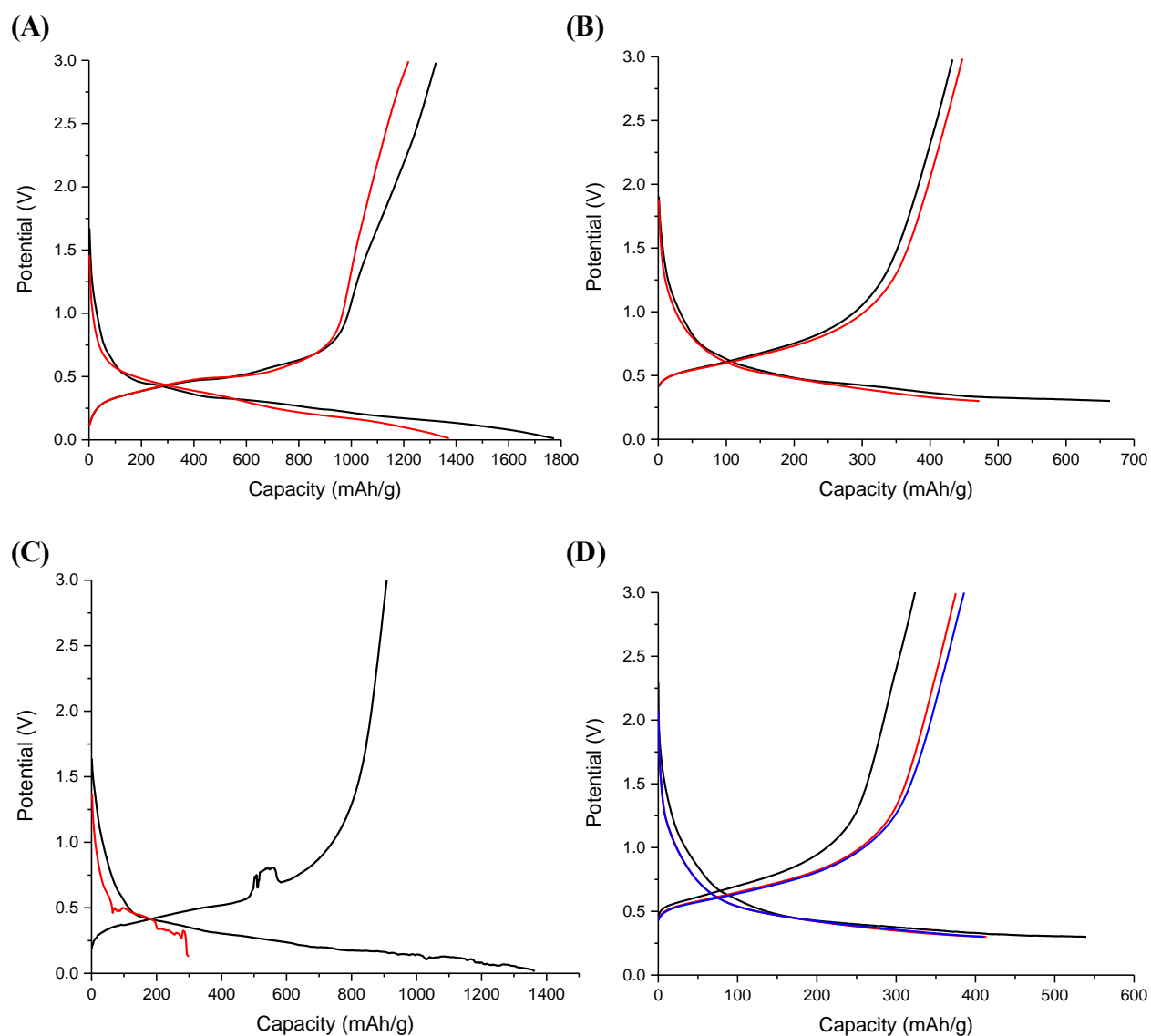
**Figure S3:** Overlaid EXAFS data in k-space,  $k^2$ -weighted, for full discharge. Fourier transformation was carried out on data from  $k=3.000$  to  $9.983$  since the data become noisy after  $k=10$ .



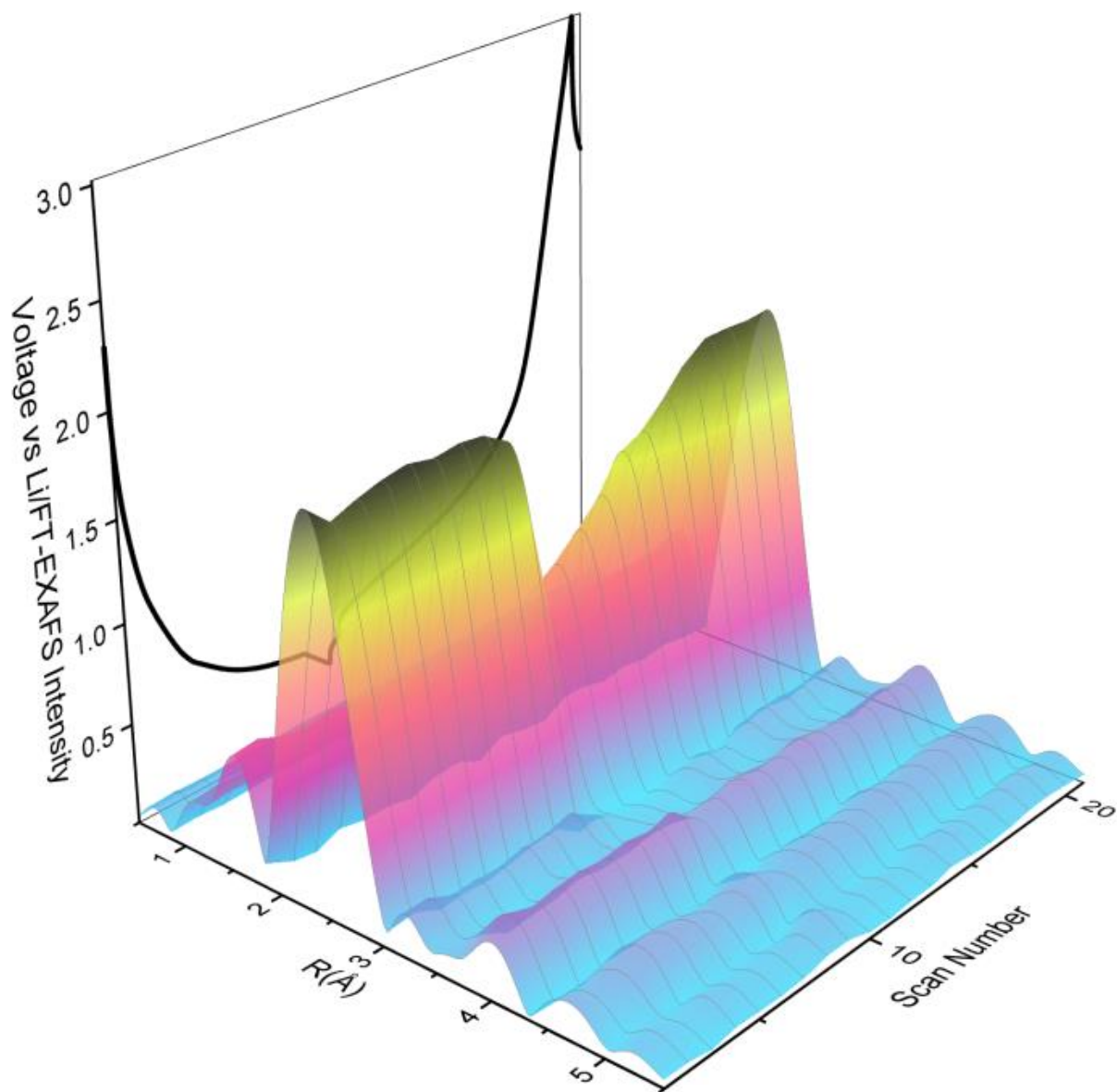
**Figure S4:** Selected Ge K-edge XANES spectra from the cell cycled to 0.01V, illustrating the shift in the absorption edge and in the “white line” peak position. The scan number for each XANES spectrum is consistent with the EXAFS spectra in Figure 7.



**Figure S5:** The second derivative of selected Ge K-edge absorption spectra from the cell cycled to 0.01V. Each  $E_0$  was selected from its  $y = 0$  intercept. The scan number for each spectrum is consistent with the EXAFS spectra in Figure 7.



**Figure S6:** The first (black), second, (red), and third (blue) galvanostatic charge/discharge profiles, plotted as voltage versus capacity, for the four coin cells presented in the manuscript. **(A)** corresponds to Figures 3A, 3B, and 4; **(B)** corresponds to Figures 5 and 6; **(C)** corresponds to Figure 7 and 9A; and **(D)** corresponds to Figures 8 and 9B.



**Figure S7:** Fourier-transformed EXAFS region at Ge K-edge over the course of the initial discharge/charge cycle to 0.3V.