

Supporting Information

Upcycling photovoltaic silicon waste into SiO anode materials

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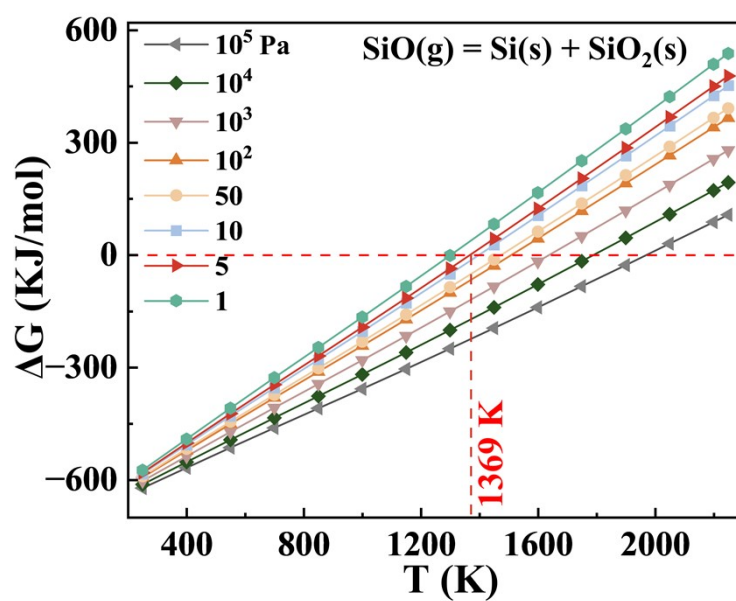


Fig. S1 Gibbs free energy change in vacuum disproportionation reaction at different vacuum levels (1- 10^5 Pa).

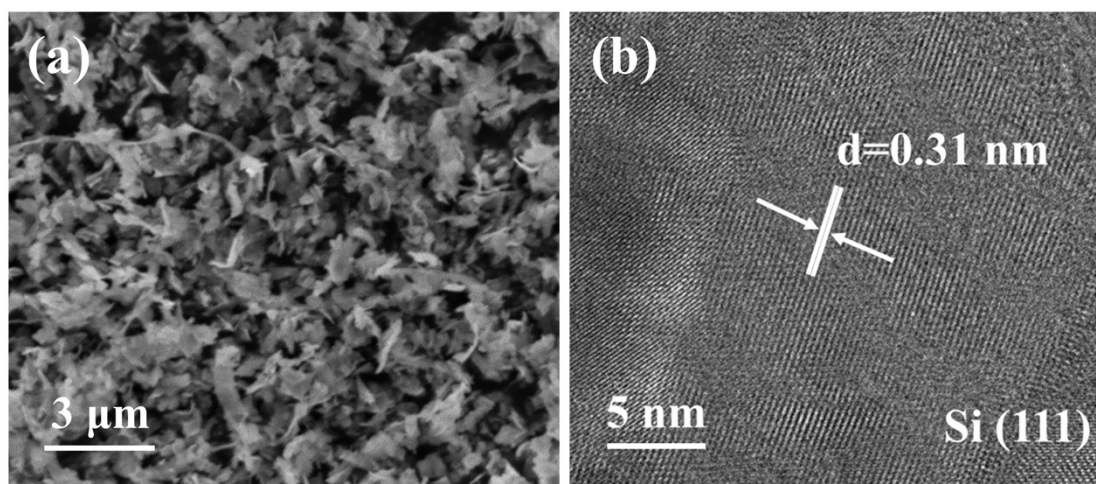


Fig. S2 SEM and corresponding HR-TEM images of WSi.

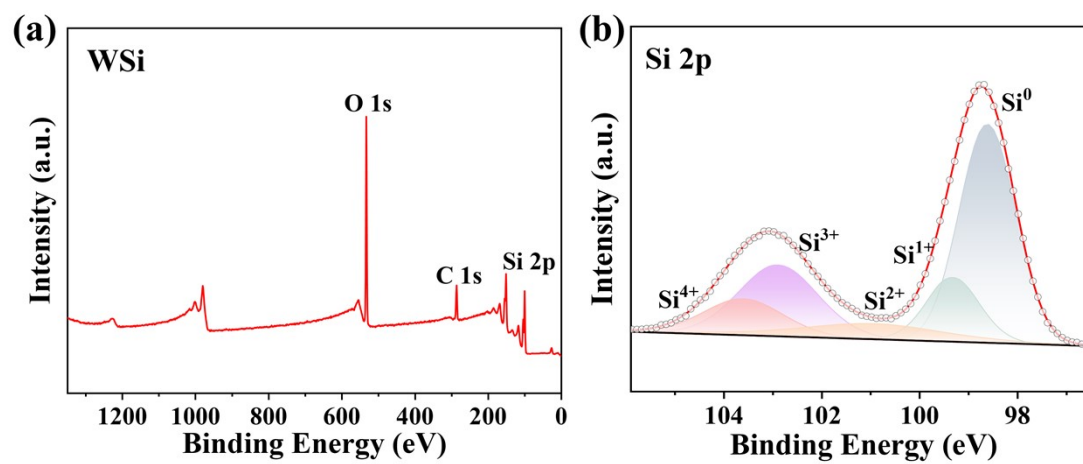


Fig. S3 (a) Survey spectrum, (b) Si 2p XPS spectra of WSi.

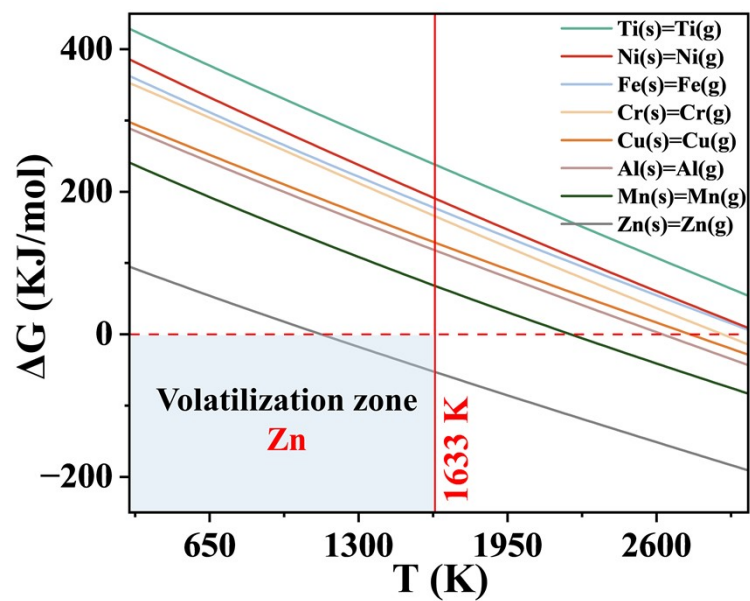


Fig. S4 Gibbs free energy change at normal pressure of primary metal impurities in WSi.

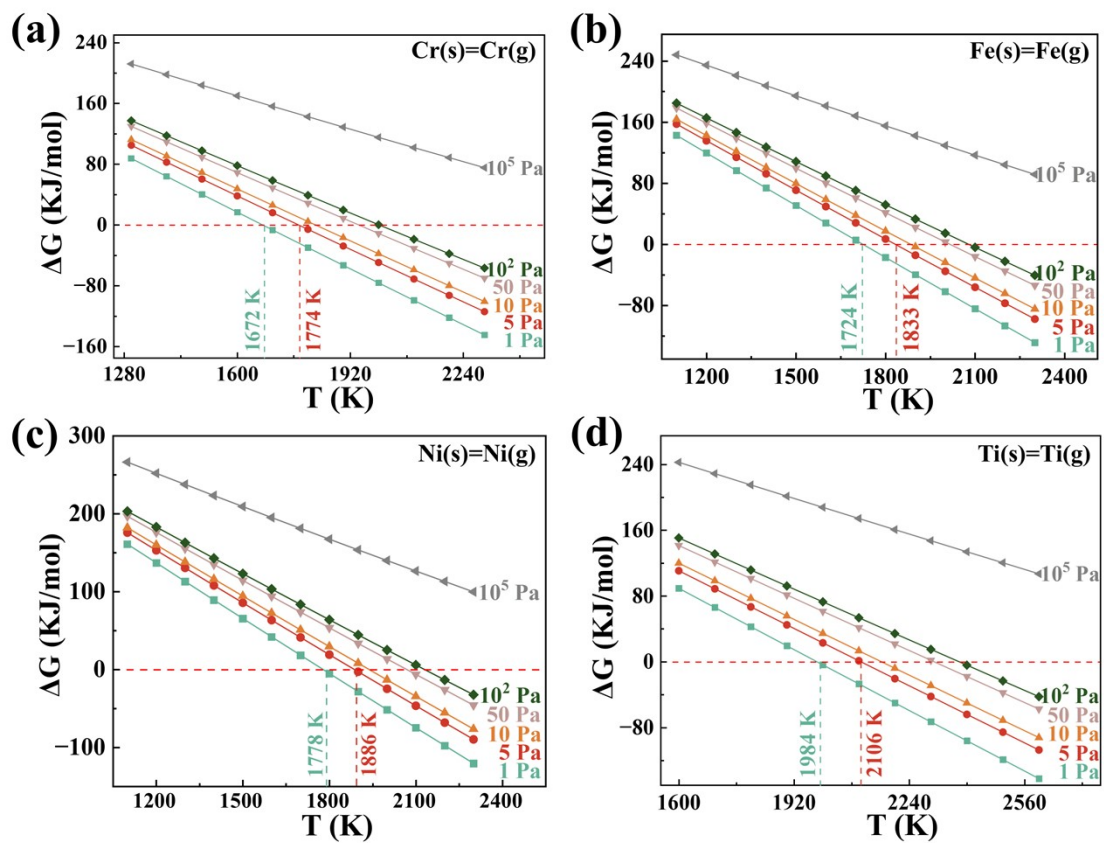


Fig. S5 (a-d) Gibbs free energy change of non-volatile metallic impurities at different vacuum levels.

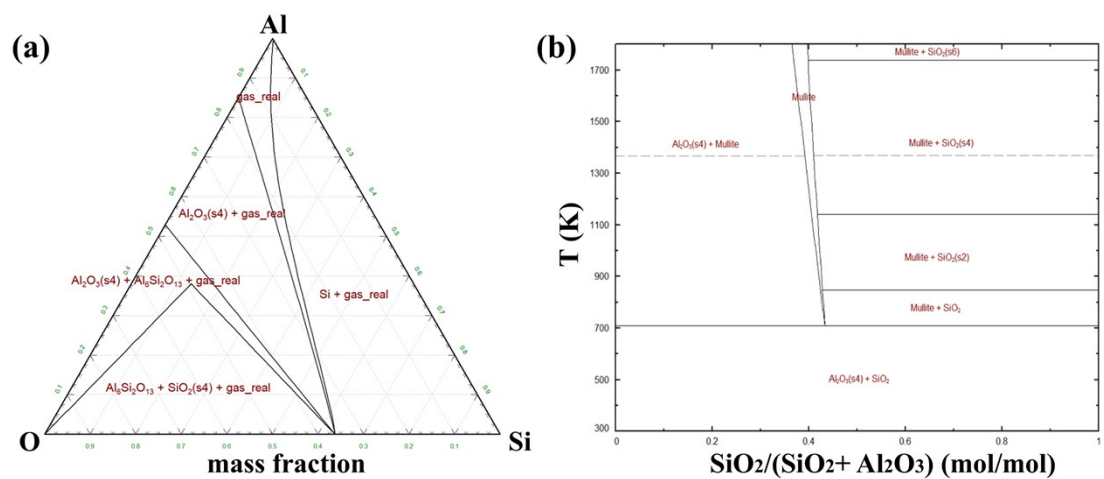


Fig. S6 (a) Ternary phase diagram of Si, Al, and O at 1360°C and 5 Pa. (b) SiO₂-Al₂O₃ mole fraction to temperature phase diagram at 5 Pa.

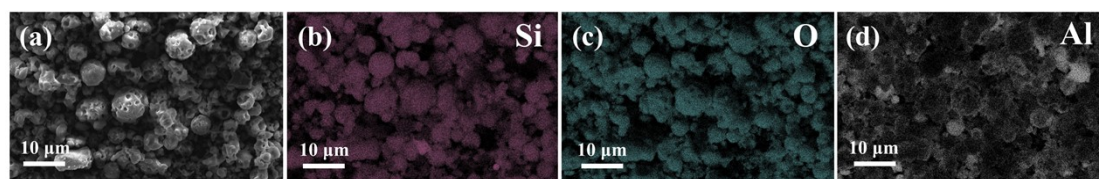


Fig. S7 (a-d) The SEM images of 5%Al residue with corresponding elemental mapping.

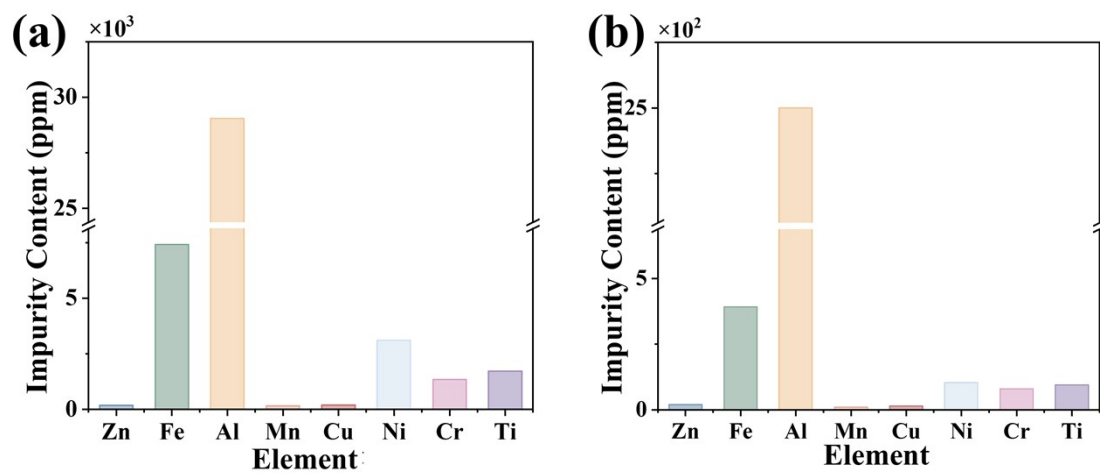


Fig. S8 ICP analysis results of impurity elements in the residual solid phases collected from (a) the furnace wall and (b) the main residue after multiple 100-kg-scale production runs.

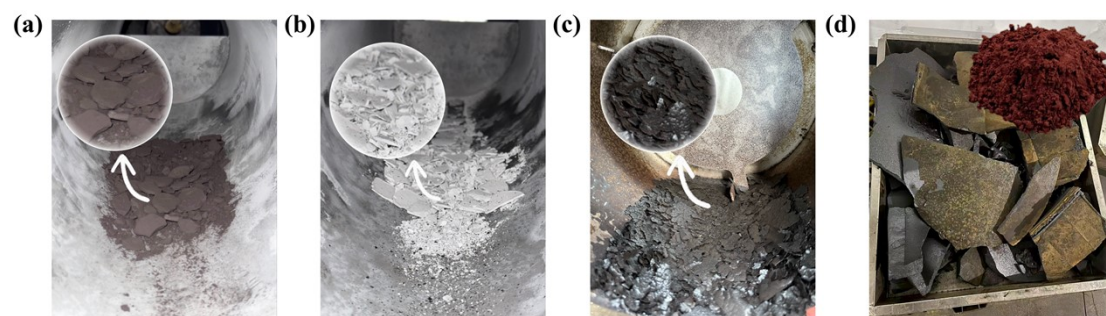


Fig. S9 Optical images of as-prepared (a) Mixture, (b) Residue, (c) SiO and (d) 100-kg-scale product (powder, the inset images).

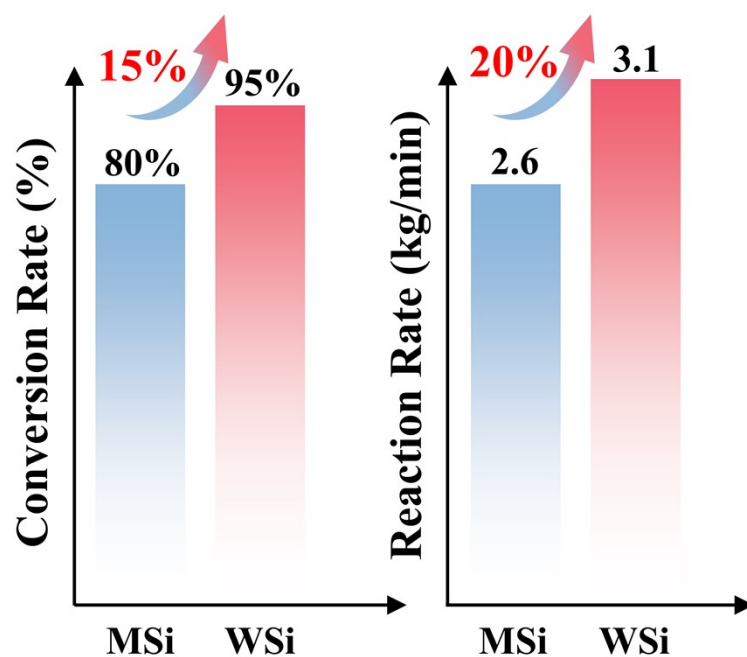


Fig. S10 Conversion rate and reaction rate of SiO synthesis from micron-sized silicon (MSi) and silicon waste (WSi) at a 100-kg-scale production.

Table S1 Metal impurity content of SiO

Method	Elements	Content (wt%)
ICP-OES/MS	Zn	0.00043
	Fe	0.00469
	Al	0.00484
	Mn	0.00229
	Cu	0.00147
	Ni	0.00033
	Cr	0.00112
	Ti	0.00019

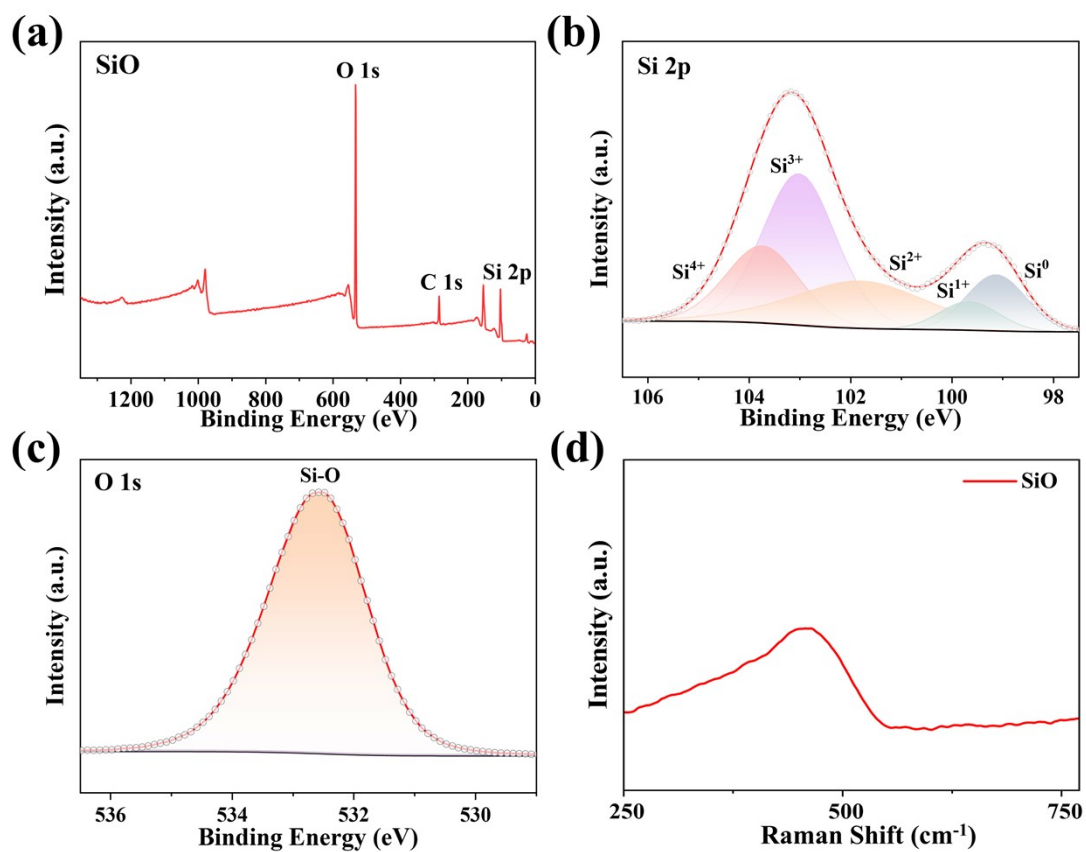


Fig. S11 (a) Survey spectrum, (b) Si 2p and (c) O 1s XPS spectra of SiO. (d) Raman spectra of SiO.

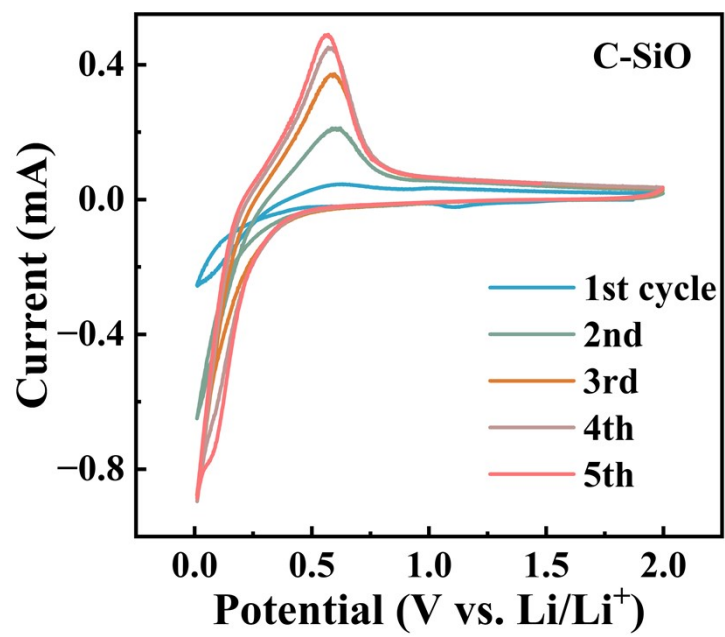


Fig. S12 The initial five CV curves of C-SiO at the scan rate of 0.1 mV s⁻¹.

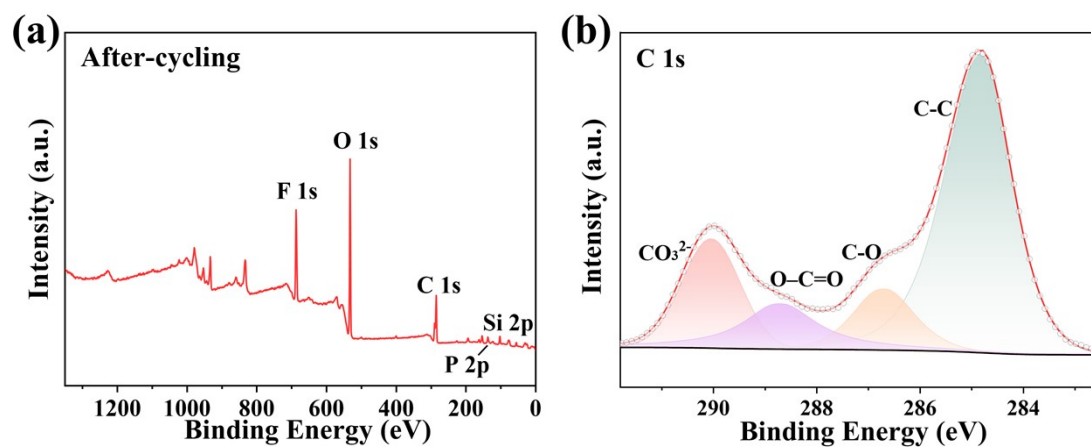


Fig. S13 (a) Survey spectrum, (b) C 1s XPS spectra of SiO after cycling.