Supporting Information

Longitudinal Strain Engineering of $Cu_{2-x}S$ by the Juxtaposed Cu_5FeS_4 phase in the $Cu_5FeS_4/Cu_{2-x}S$ _xS/Cu₅FeS₄ Nanosandwich

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Figure S1. a) TEM image and b) PXRD pattern of Cu₂₉S₁₆ nanoplates.



Figure S2. a, b) TEM images and c) histogram for crystal diameter and thickness distribution of CFS NSs.



Figure S3. a) HAADF-STEM image, corresponding elemental mapping images, and b) line profile analysis of CFS NS from top view. Green, red, and blue colors are used to denote Fe, Cu, and S, respectively.



Figure S4. a) Combined elemental mapping analyses of CFS NS from side view. b) Line profile analysis of CFS NSs from side view. Green, red, and blue colors are used to denote Fe, Cu, and S, respectively.



Figure S5. EDS spectra of CFS NSs. Sample for EDS measurement was prepared on Mo TEM grid.



Figure S6. a) HRTEM image, b) enlarged HRTEM image and corresponding FFT pattern of CFS NS from top view. c) Simulated FFT patterns of Cu₅FeS₄ (red) and Cu₂₉S₁₆ (orange), respectively.

Formula	Point Group	Atomic arrangement	Stoichiometry	Lattice strain
Cu ₂₉ S ₁₆	P ₁			
Cu ₅ FeS ₄	P _m	0	0	0
CuFeS ₂	I _{-42d}	0	0	Х
Cu ₂ FeS ₂	F_{-43m}	0	Х	-
Cu ₉ Fe ₉ S ₁₆	P _{-42m}	0	Х	-
CuFe ₂ S ₃	P_{nma}	Х	-	-
Cu ₂ Fe ₃ S ₁₀	P ₁	Х	-	-
$Cu_2Fe_4S_7$	P_{mma}	Х	-	-
Cu ₃ FesS ₈	P _{21/c}	Х	-	-

CuFeS₂



Figure S7. Comparison of diversity of copper iron sulfide phases $(Cu_xFe_yS_z)$ with $Cu_{29}S_{16}$ phase in terms of atomic arrangement, stoichiometry, and similarity of lattice parameters.



Figure S8. TEM images of CFS NSs obtained at different reaction temperatures. a, b) 150 °C, c, d) 210 °C, and e, f) 240 °C.



Figure S9. TEM images of CFS NSs with slow heating rate (4 °C /min) from a) top view and b) side view.



Figure S10. TEM images of CFS NSs prepared using different types of iron precursors; a) FeCl₃, b) Fe(acac)₂, and c) Fe(OAc)₂, respectively.



Figure S11. a) TEM image and b) corresponding PXRD analysis of CFS NSs after two-step reaction.



Figure S12. Comparison of atomic composition of CFS NSs with different thickness of Cu₅FeS₄ layers obtained by EDS. Samples for EDS measurement were prepared on Mo TEM grid.



Figure S13. TEM image of H-CFS NSs from the top view. Black arrows indicate the pores in the CFS NSs.



Figure S14. Low-scale TEM images and correlated distribution analysis dependent on the structural morphologies of a) L-CFS, b) M-CFS, c) H-CFS NSs, and d) J-CFS NPs, respectively.



Figure S15. TEM image of bent Janus-Cu₅FeS₄/Cu₂₉S₁₆ nanoplates obtained from side view. White arrows indicate the grain boundaries between Cu₅FeS₄ and Cu₂₉S₁₆.