Electronic supplementary information

Vacancy cluster induced local disordered structure for enhancement of thermoelectric property in $Cu_2ZnSnSe_4$

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This file includes:

Figures S1 to S5
Table S1

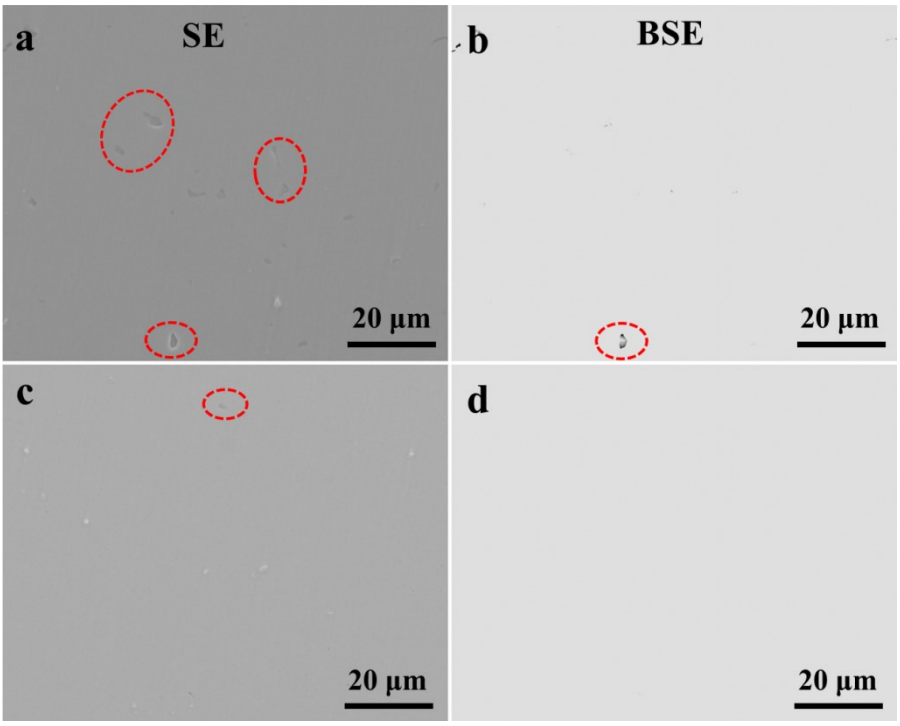

Figure S1. (a, b) Secondary electron (SE) and backscattered electron (BSE) images of pristine $Cu_2ZnSnSe_4$. (c, d) SE and BSE images of Sn deficient $Cu_2ZnSnSe_4$ sample. The red dotted circles mark the pores in the sample.

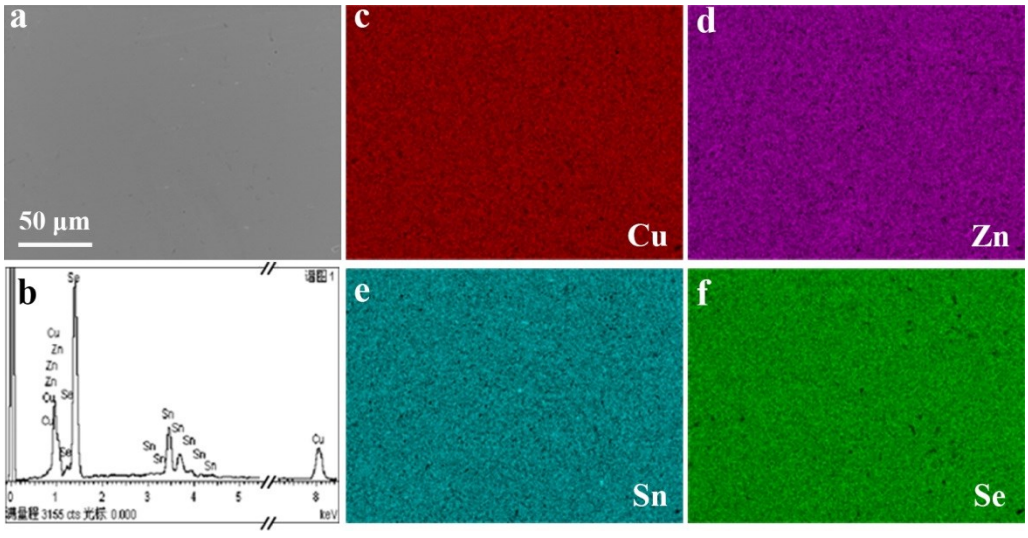

Figure S2. (a, b) SEM image of Sn deficient $Cu_2ZnSnSe_4$ sample (a) and the corresponding EDS spectra (b). (c−f) Elemental mapping images of Cu (c), Zn (d), Sn (e), and Se (f).

Table S1. Element composition of $Cu_{2(1-x)}Zn_{1-y}Sn_{1-z}Se_4$ samples by EDS analysis.

Element / Samples	Cu	Zn	Sn	Se
Pristine	0.266	0.132	0.123	0.479
x=0.02	0.263	0.134	0.124	0.480
y=0.02	0.267	0.129	0.124	0.480
z=0.02	0.267	0.134	0.119	0.480

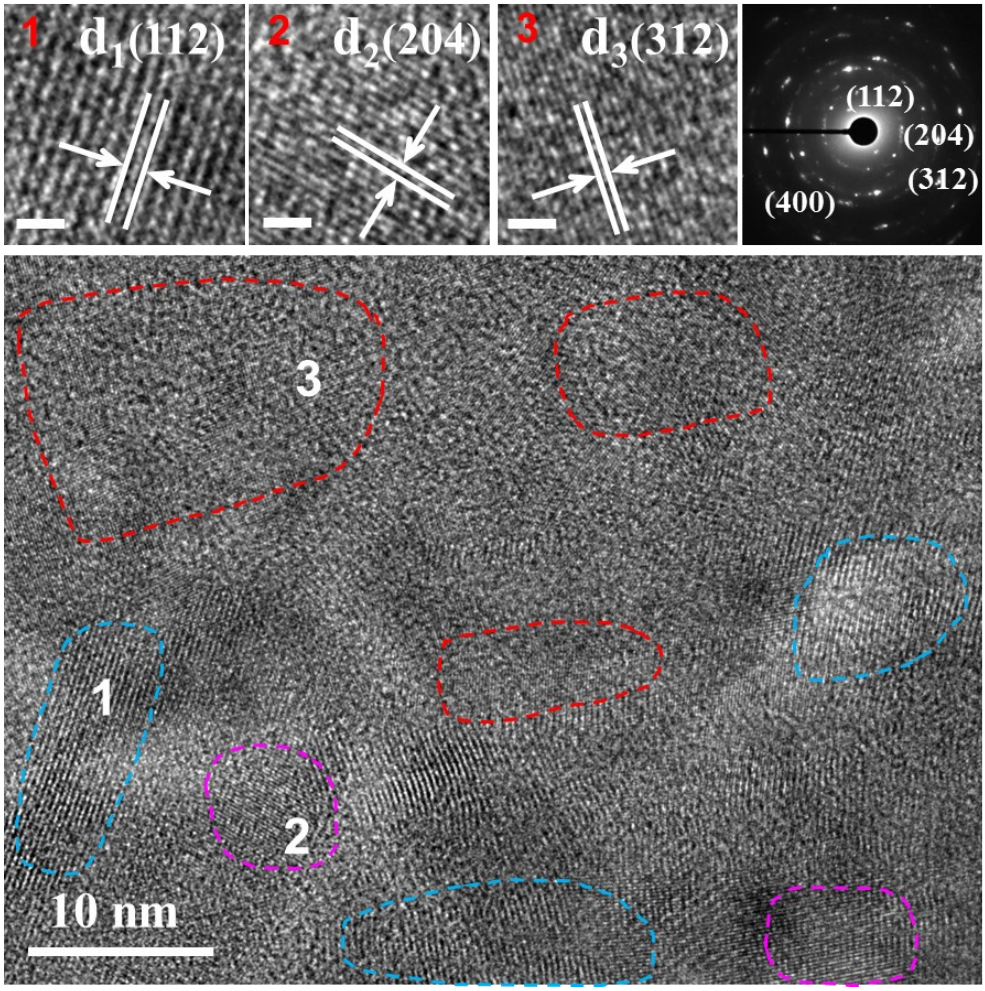

Figure S3. HRTEM and SAED characterizations of Cu-deficient $Cu_2ZnSnSe_4$, showing local disordered oriented domains. Panel 1, 2, and 3 are the enlarged views of the corresponding marked areas in the HRTEM image, scale bar, 1 nm.

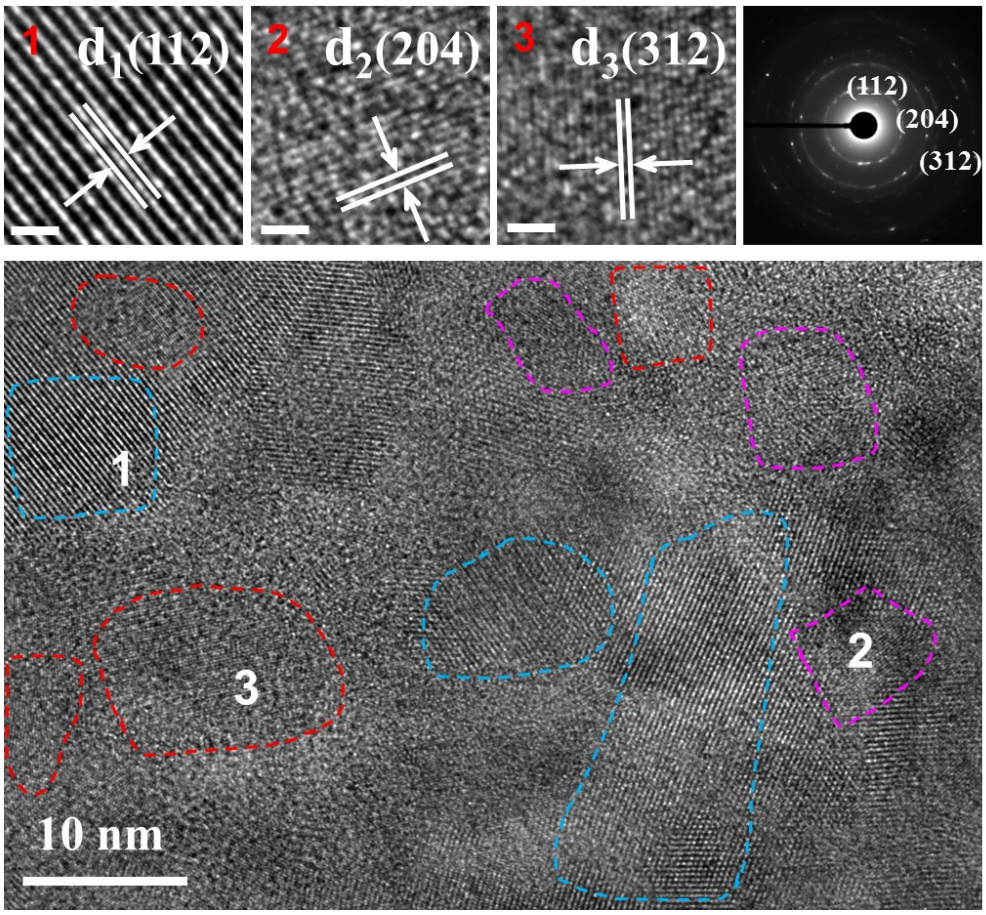

Figure S4. HRTEM and SAED characterizations of Zn-deficient $Cu_2ZnSnSe_4$, showing local disordered oriented domains. Panel 1, 2, and 3 are the enlarged views of the corresponding marked areas in the HRTEM image, scale bar, 1 nm.

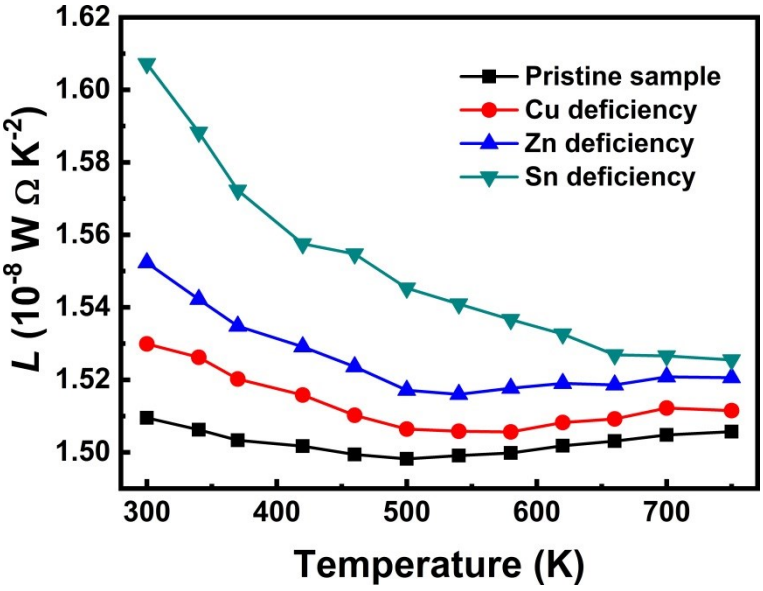

Figure S5. Temperature-dependent Lorenz number for $Cu_{2(1-x)}Zn_{1-y}Sn_{1-z}Se_4$ samples