Supporting Information

Colossal Thermoelectric Enhancement in $Cu_{2+x}Zn_{1-x}SnS_4$ solid solution by local disordering of crystal lattice and multi-scale defect engineering

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Table S1. The price of elements and their content in the earth's crust (from www.1688.com).

elements	$/ton	Element Content in the earth (ppm)
Cu	6000	100
S	200	500
Zn	1500	200
Sn	16000	3
Pb	2000	15
Sb	10000	0.5
Ti	20000	6300
Te	100000	1
Bi	20000	20
Se	100000	0.05
Ag	300000	0.07
Mg	4000	20000
Ni	50000	180

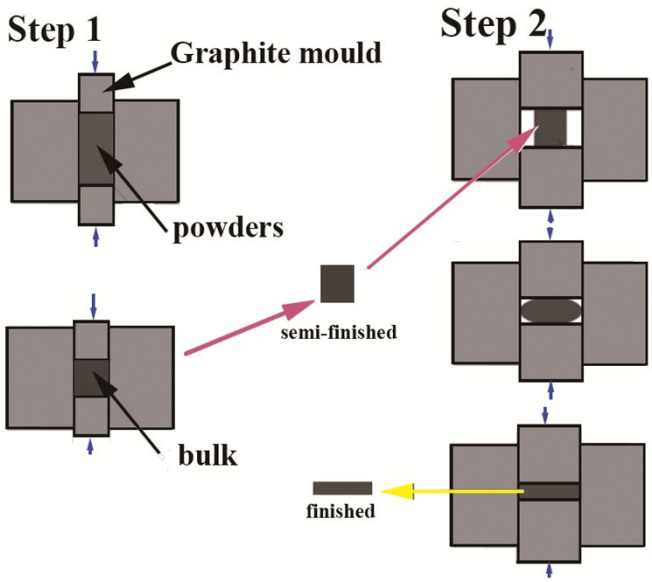

Figure S1. Schematic diagram of hot forging process.

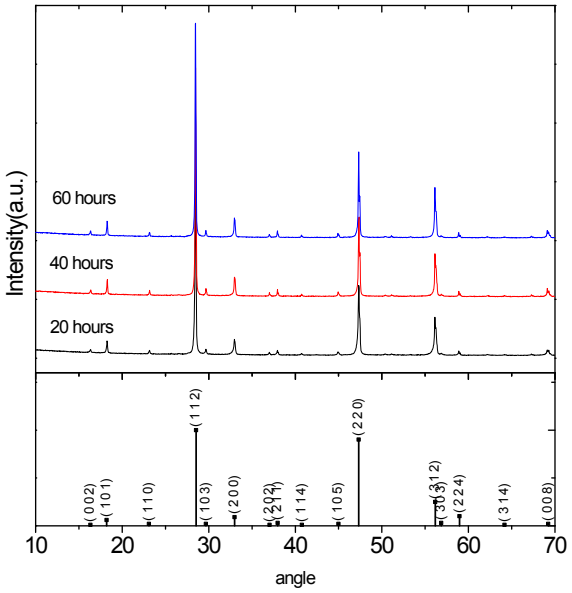

Figure S2. XRD patterns of Cu_2ZnSnS_4 powders ball milled at 350 rpm for different times.

(The data were collected using Siemens D5000 (Karlsruhe, Germany) in Queen Mary University of London.)

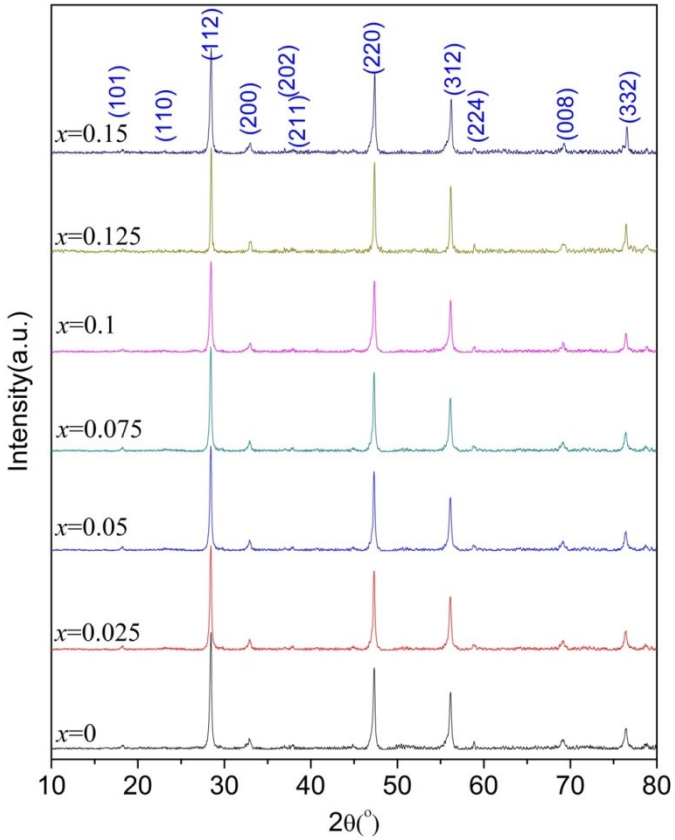

Figure S3. XRD patterns of $Cu_{2+x}Zn_{1-x}SnS_4$ powders ball milled at 350 rpm for 40 hours (The data were collected using Rigaku D/max-rB (Akishima, Tokyo, Japan) in Tsinghua University.)

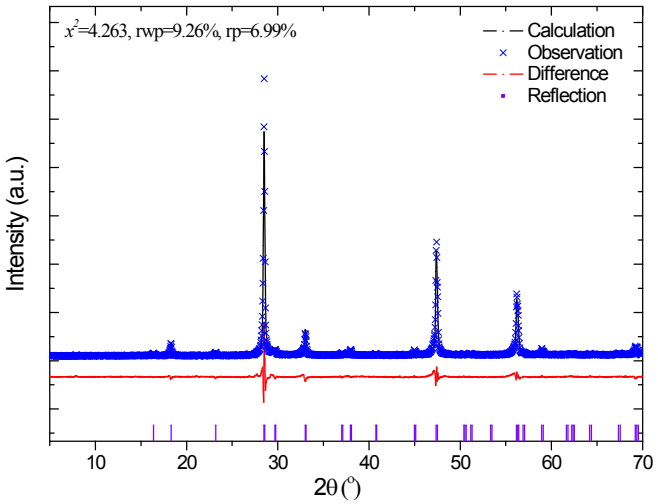

Figure S4 XRD data including profile fit, profile difference, and profile residuals of the corresponding Rietveld fit of $Cu_{2.125}Zn_{0.875}SnS_4$ bulk after hot forging

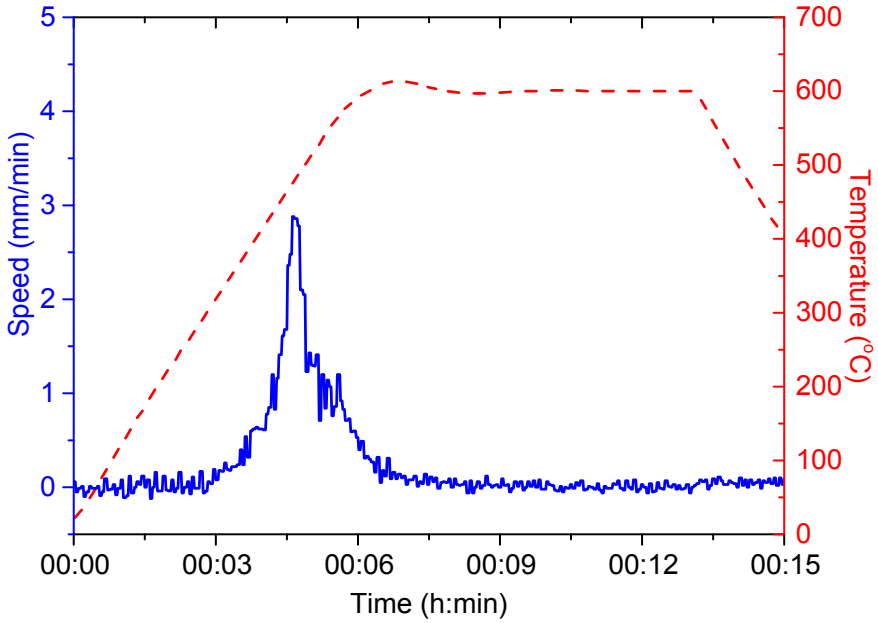

Figure S5. The SPS outputs for $Cu_{2.125}Zn_{0.875}SnS_4$ sintered at 600 °C for 8 mins under 60 MPa (first step).

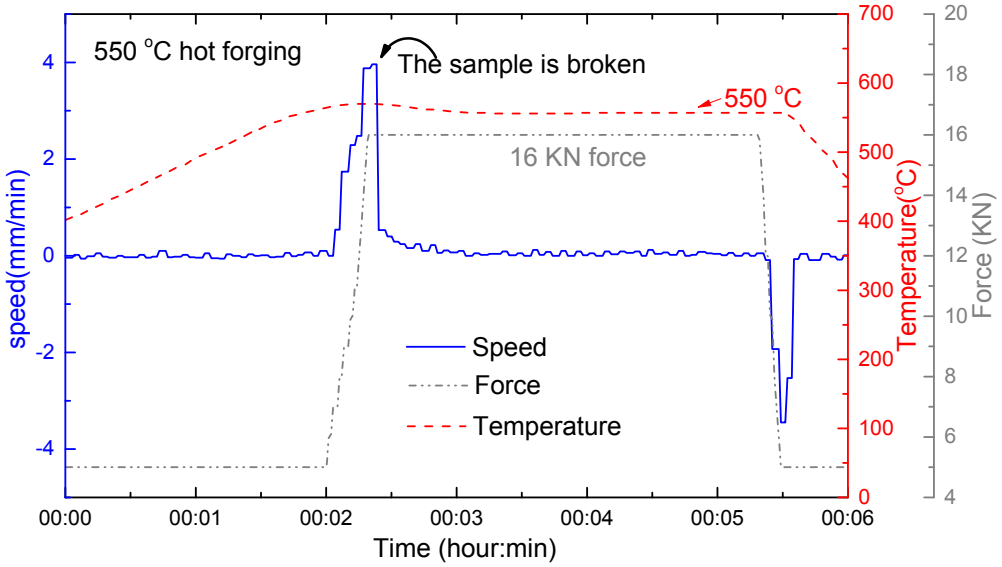

Figure S6. The SPS outputs of $Cu_{2.125}Zn_{0.875}SnS_4$ prepared by hot forging at 550 °C under 50 MPa (second step). The sample broke at 0.5 min.