2021「中技社科技獎學金」

2021 CTCI Foundation Science and Technology Scholarship

研究獎學金

Research Scholarship

Advanced Thermoelectric Materials and Green Energy laboratory

~Where this a Delta-T, there is an Electricity~

國立交通大學 National Chiao Tung University

High performance GeTe-based thermoelectric materials

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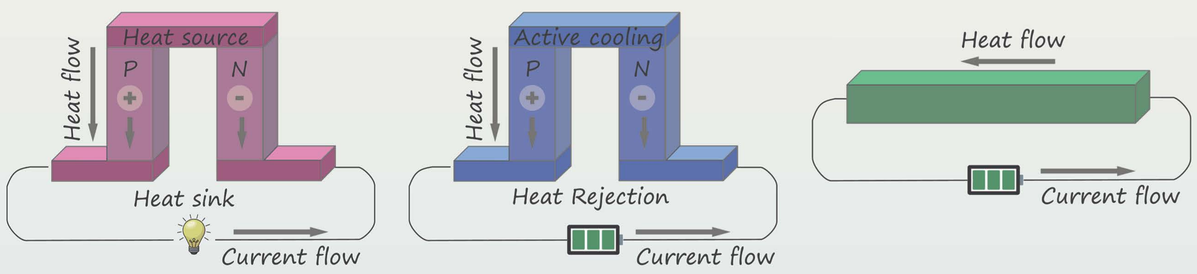
Research background

Thermoelectric (TE) materials are capable of converting the undesired waste heat into precious electricity. According to the fundamental theory of material science, the phase diagram provides information on the target materials from different points of view.

(i) Seebeck effect (ii) Peltier effect (iii)Thomson effect



Promising TE material Germanium-telluride (GeTe)

p-type semiconductor

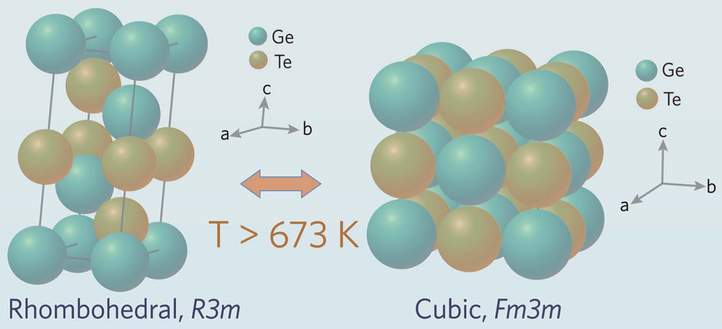
Environmental friendly material

Multi-valence bands

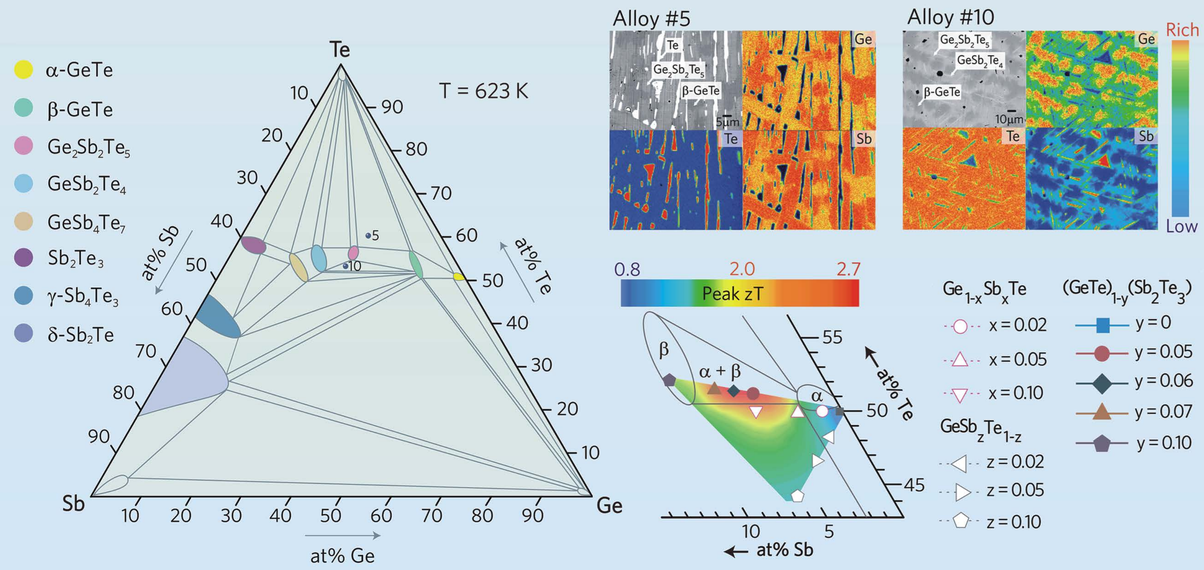
High electrical / thermal conductivity

Phase change material

Ferroelectric Rashba semiconductor

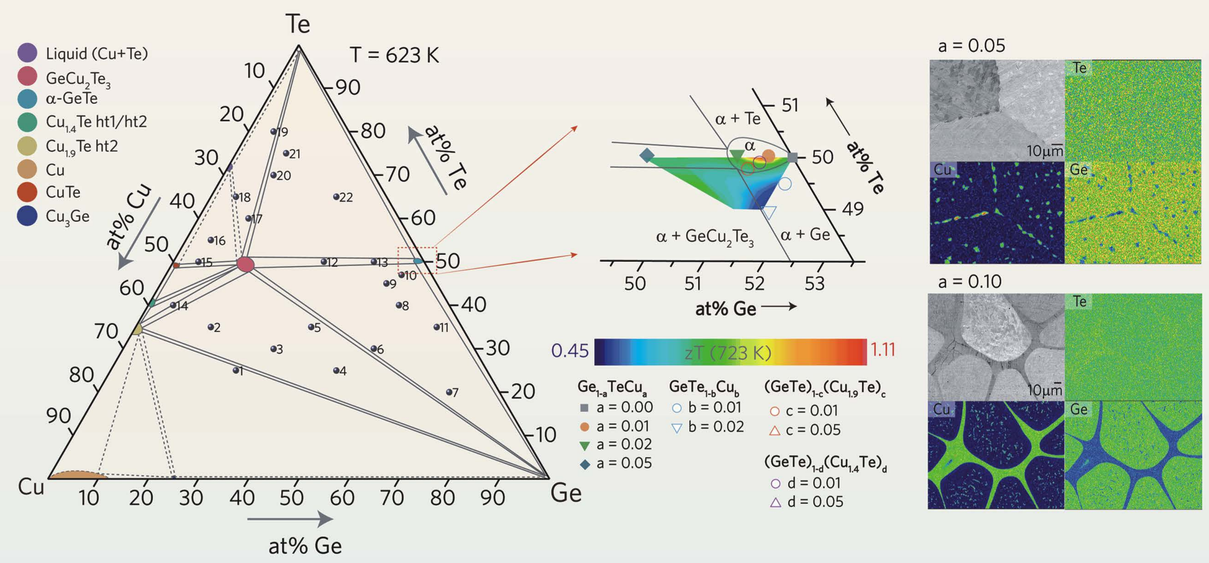


Sb-GeTe ternary phase diagram



Y. F. Tsai, P. C. Wei*, L. Chang, K. K. Wang, C. C. Yang, Y. C. Lai, C. R. Hsing, C. M. Wei, J. He, G. J. Snyder and H. J. Wu*, "Compositional Fluctuations Locked by Athermal Transformation Yielding High Thermoelectric Performance in GeTe", Adv. Mater. 33, 2005612 (2021).

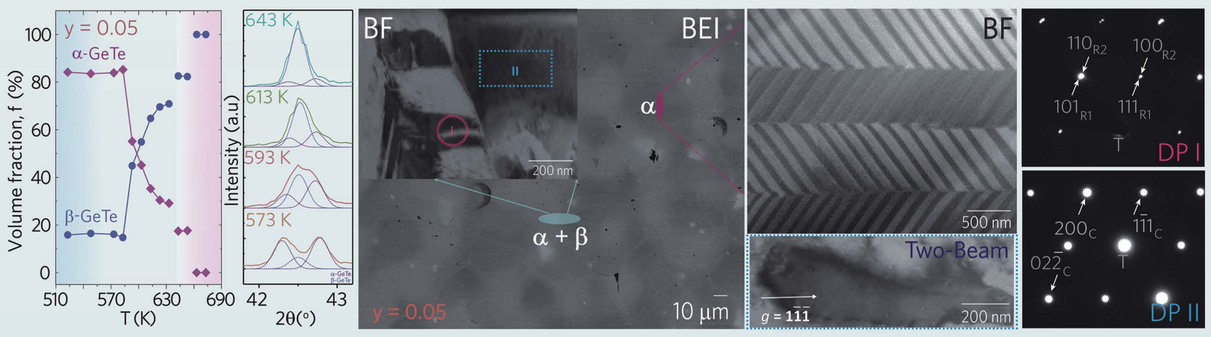
Cu-GeTe ternary phase diagram



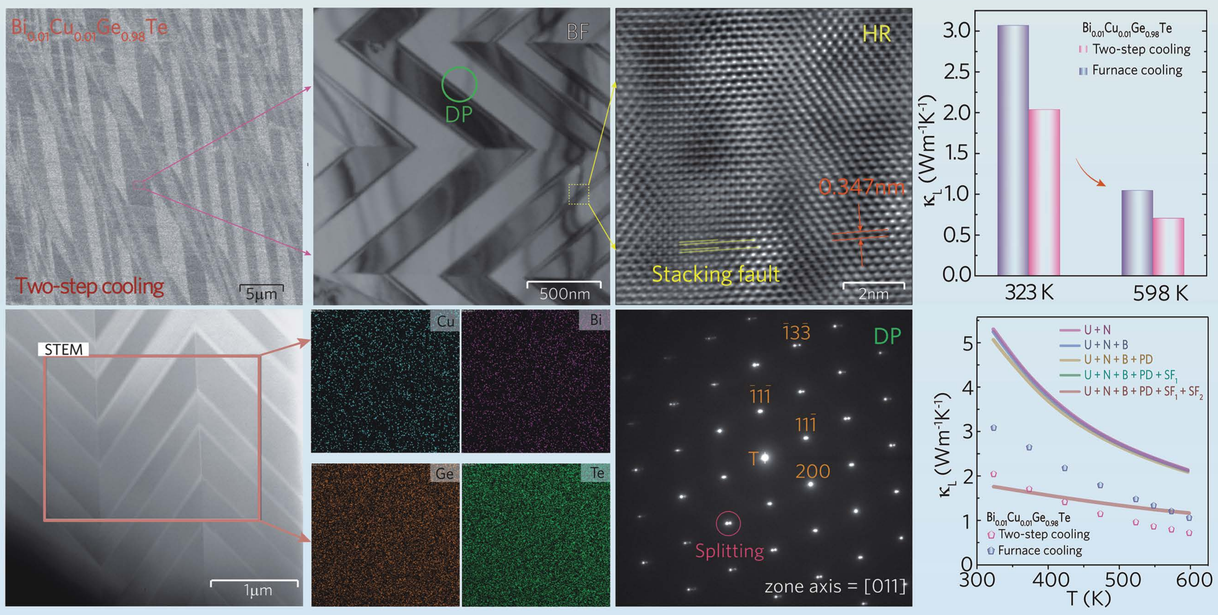
Y. F. Tsai, M. Y. Ho, P. C. Wei and H. J. Wu*, "Hierarchical twinning and light impurity doping enable high-performance GeTe thermoelectrics", Acta Mater. 222, 117406 (2022).

Material analysis and theoretical calculation

(i) Co-existence of α and β in Sb-GeTe



(ii) Induced stacking fault in Cu-GeTe



Conclusion

We constructed the phase diagram through several material analysis for GeTe-based TE alloys. In short, these researches provide reliable methods and build up solid paths for the properties' manipulation in GeTe-based TE alloys.

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