Supporting Information

Optimizing output performance and parasitic depletion of Bi_2Te_3-based thermoelectric generators by using a high-density approach

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Phase composition

The X-ray diffraction patterns of p-type (Bi-Sb-Te) and n-type (Bi-Te-Se) materials are consistent with the R-3m space group with hexagonal layered structures, and no impurities are observed, as marked in Fig. S1.

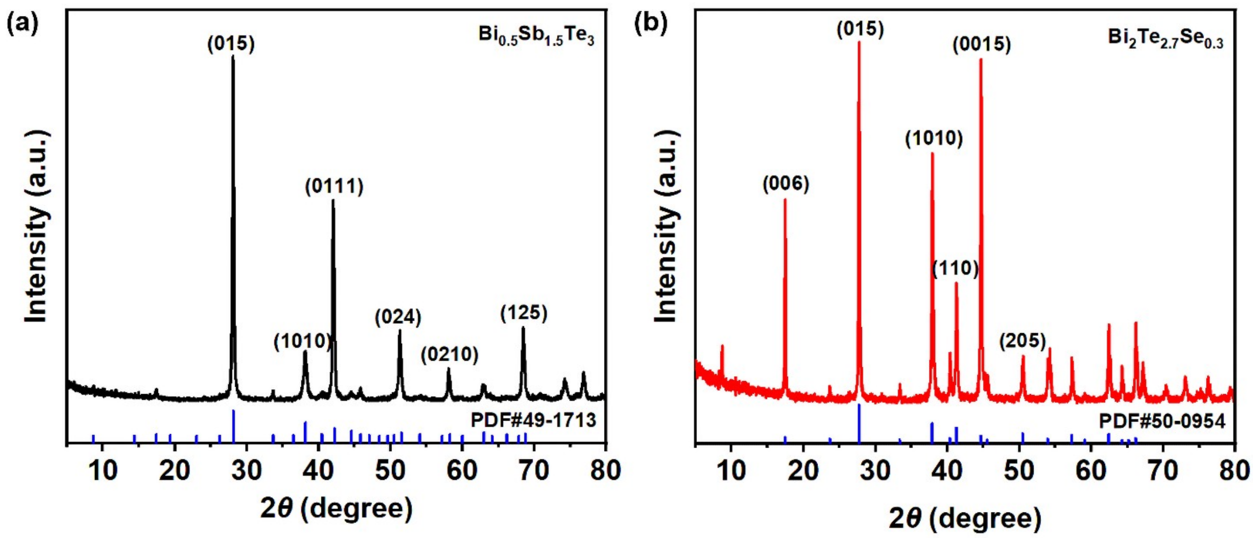

Fig. S1 Phase characterization diagram of commercial Bi_2Te_3-based thermoelectric materials. The X-ray diffraction patterns of (a) p-type and (b) n-type materials.

Table S1 The compositions of commmercial p- and n-type Bi_2Te_3-based materials.

	P-type			N-type		
Element	Bi	Sb	Te	Bi	Te	Se
at.%	8.92	32.77	58.31	40.35	55.92	3.73
wt.%	14.02	30.01	55.96	53.16	44.98	1.86

The average Seebeck coefficient in Finite element module

The average Seebeck coefficient values derived from ΔU-ΔT curves can be used to verify the commercial materials, and as shown in Fig. S2.

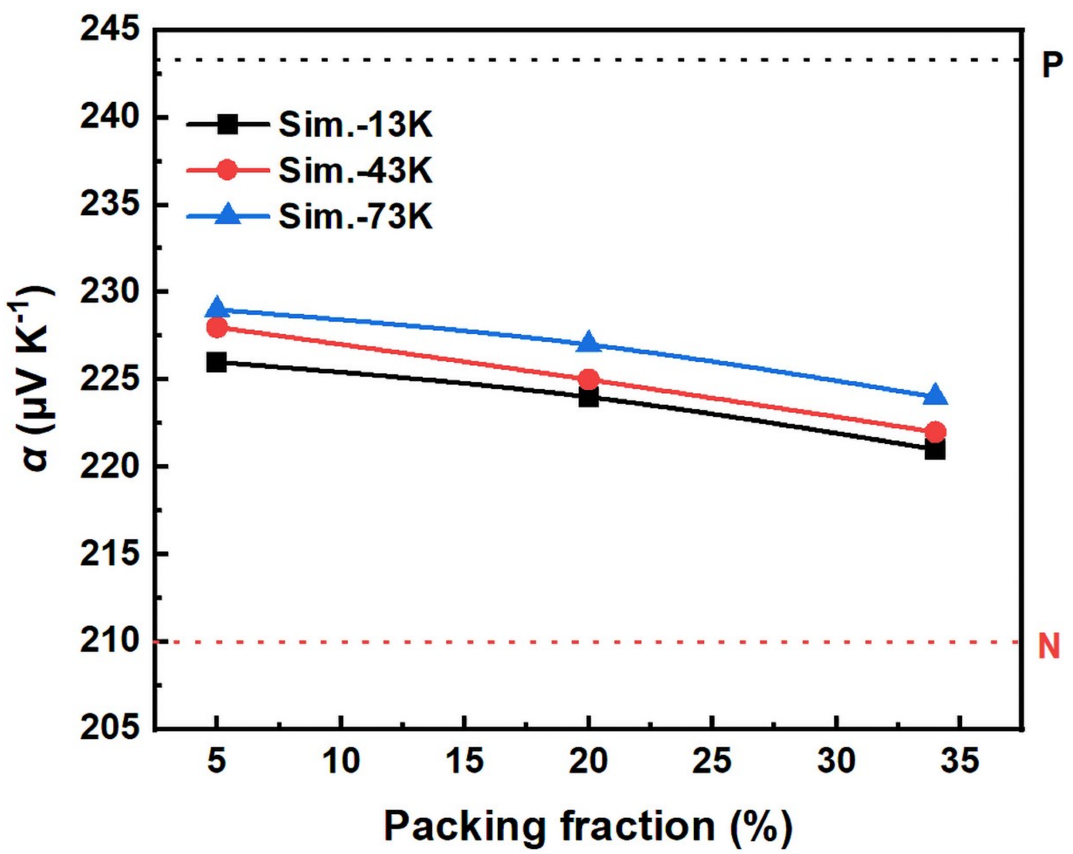

Fig. S2 Packing fraction dependence of average Seebeck coefficient values of 200-Tcs (f = 20%), 50-Tcs (f = 5%) and 50-Tcs (f = 34%) TEGs at different ΔT.

Experimental contact resistivity used for V-TDE

To shed more light on the parasitic depletion, especially for contact depletion, systematic characterizations of r_c have been done based on a four-probe method, and the calculated ρ_c has been introduced into the V-TDE, Aa shown in Fig. S3(a)-(b).

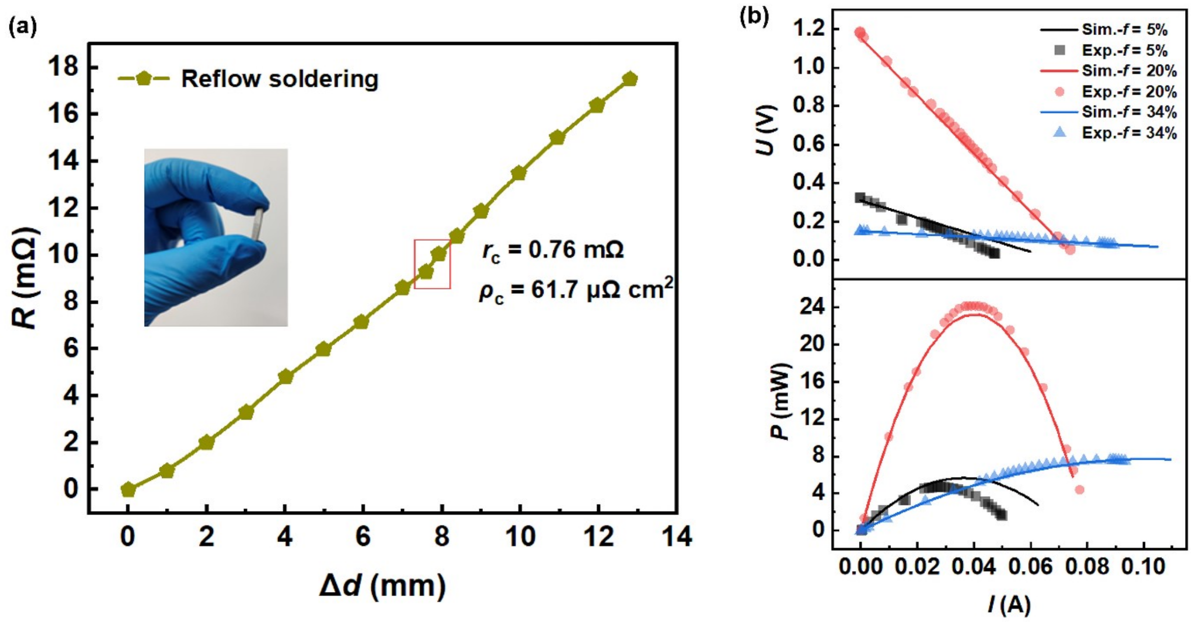

Fig. S3 (a) The electrical contact resistance (r_c) of typical reflow soldering sample, and (b) the simulation and experimental value of TEGs (*f*: 5%, 20% and 34%).

338-Tcs TEG with destroyed linear relationship between P_{max} and f

For low temperature environment, the TEG possesses outstanding performance by remaining the maximum effective ΔT, however, the ability would be weakened at high temperatures, resulting in higher average temperature of each leg, larger internal resistance, and lower open-circuit voltage than liner values. And the average Seebeck coefficient values are within the range made by p- and n-type materials at ΔT of 13 K and 43K, yet they are below those at ΔT of 73 K, as shown in Fig. S4 (a) and (b).

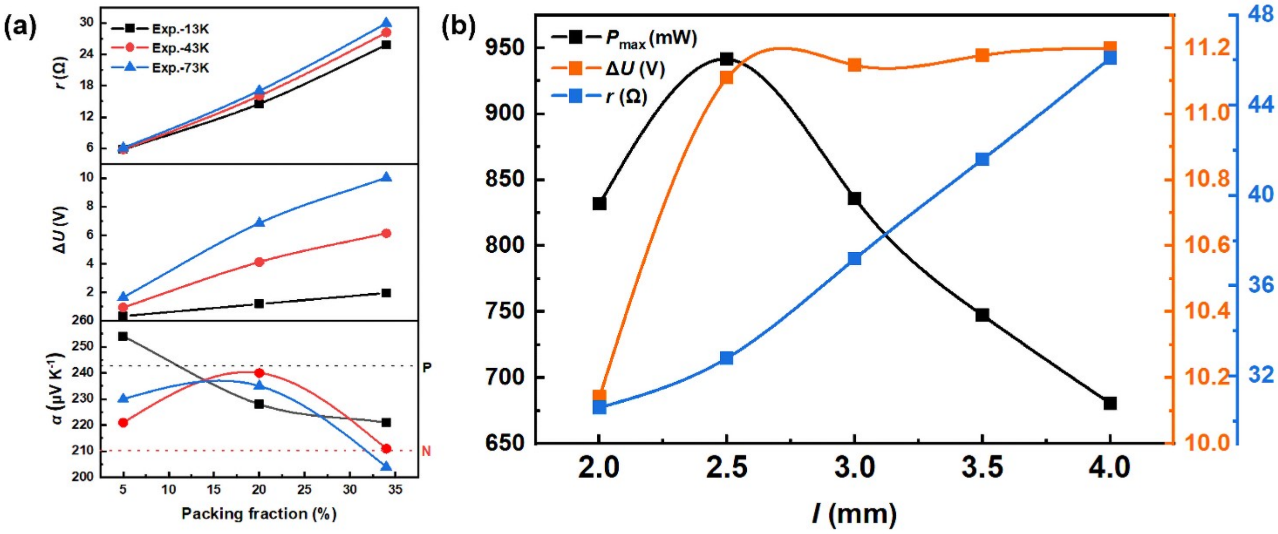

Fig. S4 (a) Packing fraction dependence of r, ΔU and average Seebeck coefficient values of 50-Tcs (f = 5%), 200-Tcs (f = 20%) and 338-Tcs (f = 34%) TEGs at different ΔT. (b) The leg height (l) dependence of $P_{\max}$, ΔU and r of 338-Tcs TEG between 293K and 366K.