1 <u>**Supporting Information**</u>

2 **Entropy-stabilized perovskite oxide $Ba_{0.1}Ca_{0.1}La_{0.05}Sr_{0.75}Ti_{0.85}Nb_{0.15}O_3$ with improved**

3 **thermoelectric performance for high-temperature waste heat recovery**

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6 *Plasmonics and Perovskites Laboratory, Department of Materials Science and Engineering,*

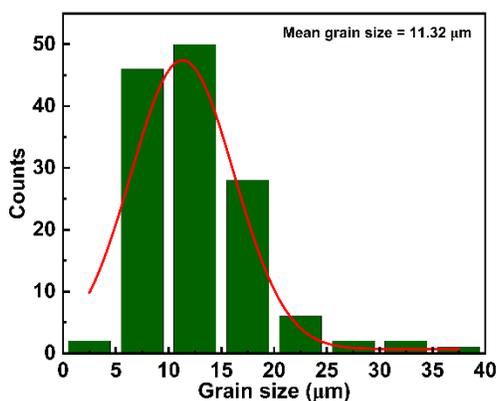7 *Indian Institute of Technology, Kanpur, UP 208016, India*

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10 Fig. S1. Grain size distribution

11 Table S1. Refined structural parameters of BCLSTN ceramic after Rietveld refinement of the XRD

12 data using $Pm\bar{3}m$ space group.

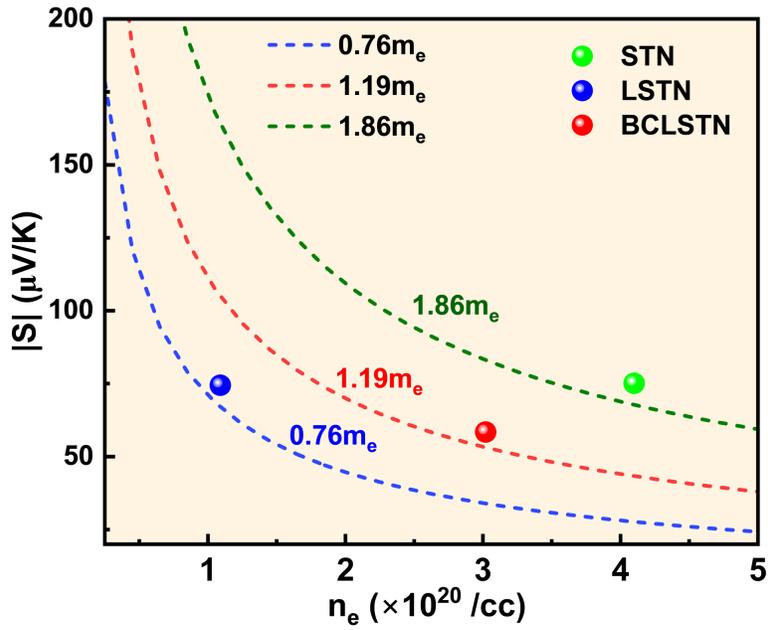| Elements	x	y	z	B_iso (Å^2)
Sr/Ca/Ba/La	0	0	0	0.59260/0.76260/0.65260/0.60260
Ti/Nb	0.5	0.5	0.5	0.16400/0.00062
O1	0.5	0	0.5	2.87452
O2	0.5	0.5	0	3.35888
a = b = c = 3.92792 Å, $\chi^2 = 1.76$				
Rp: 21.1 Rwp: 20.5 Rexp: 15.40				

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S2. UV-vis analysis plot from diffusive reflectance spectroscopy (DRS):

$E_g = 3.23 \pm 0.05$ eV
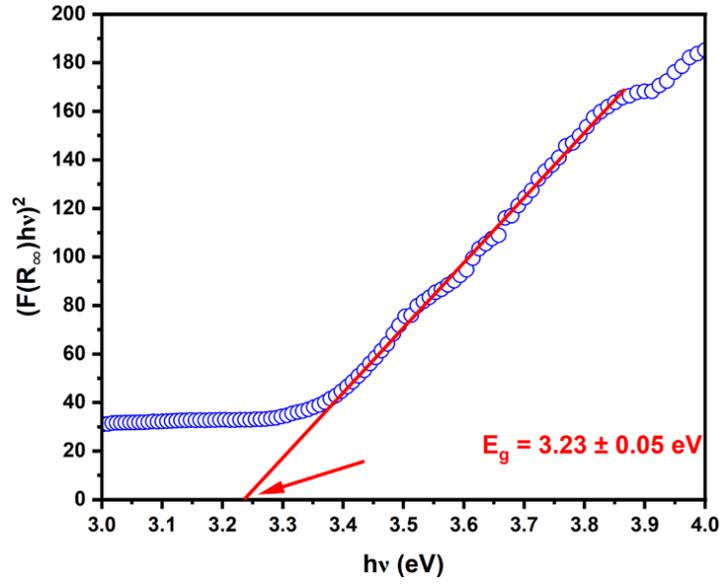
Fig. S2. Bandgap calculations from the K-B plot of BCLSTN.
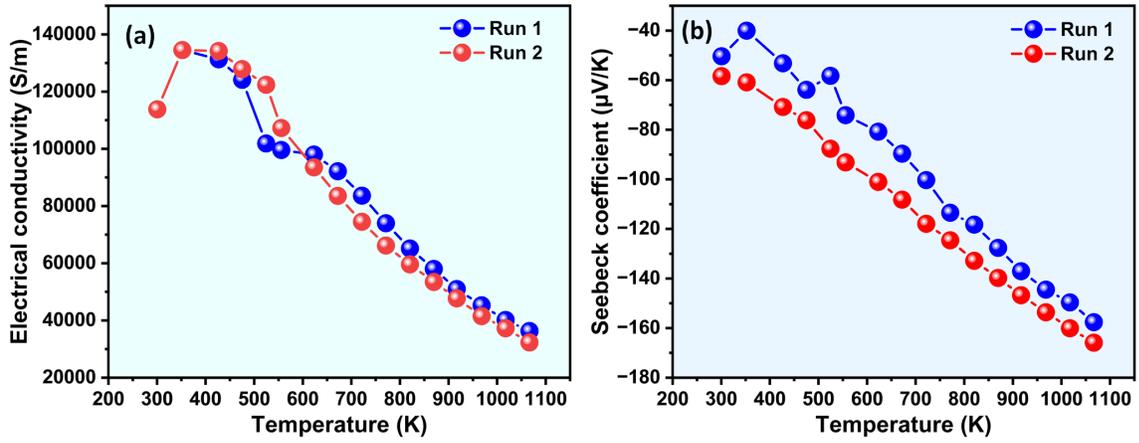

Fig. S3. Pisarenko plot at 300 K.
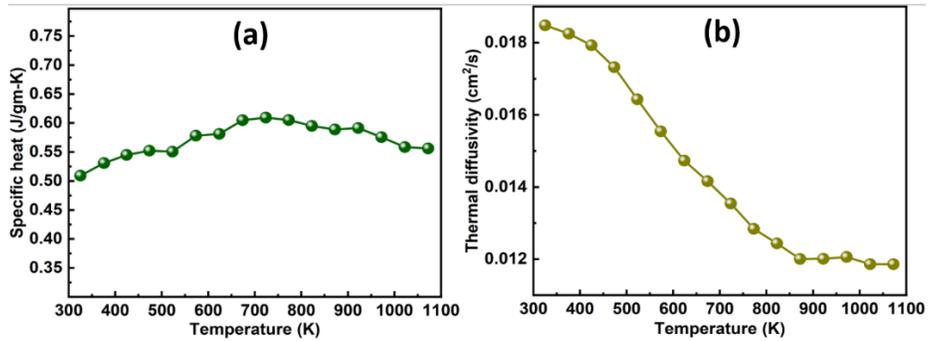
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24   Fig. S4. Reproducibility data of electrical conductivity and Seebeck coefficient of LCBSTN

25   composition.

26   **S3. Specific heat and thermal diffusivity graph of the sintered sample with a density of 5.09**

27   **g/cc:**

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29   Fig. S5. (a) Specific heat, (b) Thermal diffusivity of BCLSTN sample.
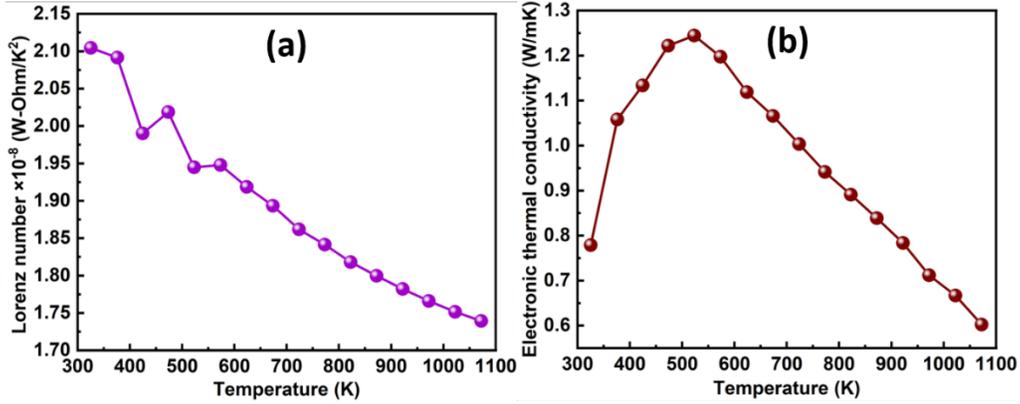
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35 **S4. Specific heat and thermal diffusivity graph:**

37 Fig. S6. (a) Lorenz number and (b) electronic thermal conductivity of BCLSTN ceramic.

38 **S5. Debye temperature determination**

39 Calculation of the Debye temperature (θ_D) of the BCLSTN system has been performed using the
40 following equation:

$$\theta_D = \frac{h}{k}\left[\frac{3n}{4\pi}\left(\frac{N_A\rho}{M}\right)\right]^{1/3}\vartheta_m \qquad (S1)$$

42 where h stands for Planck's constant, k for Boltzmann's constant, M represents the molecular
43 weight, N_A is Avogadro's number, ρ denotes the density, n is the number of atoms per formula
44 unit, and ϑ_m is the mean sound velocity in the material. The mean sound velocity (ϑ_m), is derived
45 using the bulk modulus (B) and shear modulus (G) as follows:

$$\text{Poisson's ratio: } \nu = \frac{(3B - 2G)}{(6B + 2G)} \qquad (S2)$$

$$\vartheta_m = \left[\frac{1}{3}\left(\frac{2}{\vartheta_t^3} + \frac{1}{\vartheta_l^3}\right)\right]^{-1/3} \qquad (S3)$$

$$\vartheta_l = \left(\frac{B + \frac{4}{3}G}{\rho}\right)^{1/2} \qquad (S4)$$

$$\vartheta_t = \left(G/\rho\right)^{1/2} \qquad (S5)$$

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Table S2. Table for B, G, ρ, M, ϑ_l, ϑ_t, ϑ_l and θ_D for BCLSTN composition.

| B (Pa)	G (Pa)	ρ (kg/m³)	M (gm)	ϑ_l (m/s)	ϑ_t (m/s)	ϑ_m (m/s)	θ_D(K)
1.24×10^{11}	8.11×10^{10}	5093.3	193.02	6755.76	3990.84	4421.40	526.52

Table S3. Fitting parameters of Debye-Callaway's model for Umklapp scattering pre-factor (B) and electron-phonon scattering pre-factor (C).

Point defect scattering A [s³]	Phonon-phonon (Umklapp) scattering factor B [sK⁻¹]	Electron-phonon scattering factor C [s]
5.226×10^{-41}	1.257×10^{-19}	4.685×10^{-17}
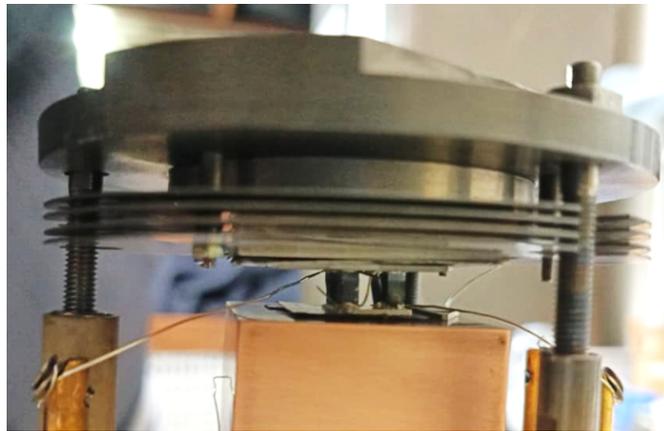
Fig. S7. Setup and fabricated TEG module.