

Supporting Information

**Thermoelectric and mechanical properties of
environmentally friendly $\text{Mg}_2\text{Si}_{0.3}\text{Sn}_{0.67}\text{Bi}_{0.03}/\text{SiC}$
composites**

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Table S1. Area scan results (percentages) of the $\text{Mg}_2\text{Si}_{0.30}\text{Sn}_{0.67}\text{Bi}_{0.03}$ sample.

Area	Mg	Si	Sn	Bi
1	66.1	10.5	22.4	1.0
2	66.6	10.3	22.2	0.9
3	66.4	10.1	22.8	0.7
Average	66.3	10.3	22.5	0.9
Nominal composition wt.-%	66.7	10.0	22.3	1.0

Table S2. Densities and specific heat of $\text{Mg}_2\text{Si}_{0.30}\text{Sn}_{0.67}\text{Bi}_{0.03}$ / SiC composites.

Sample	Density Archimedes	Theoretical density	Cp
	(g.cm ⁻¹)	(%)	
$\text{Mg}_2\text{Si}_{0.30}\text{Sn}_{0.67}\text{Bi}_{0.03}$	3.19	99	0.524
$\text{Mg}_2\text{Si}_{0.30}\text{Sn}_{0.67}\text{Bi}_{0.03}$ + 0.5 wt-% SiC	3.18	98	0.527
$\text{Mg}_2\text{Si}_{0.30}\text{Sn}_{0.67}\text{Bi}_{0.03}$ + 1.0 wt-% SiC	3.19	99	0.531
$\text{Mg}_2\text{Si}_{0.30}\text{Sn}_{0.67}\text{Bi}_{0.03}$ + 1.5 wt-% SiC	3.18	98	0.535
$\text{Mg}_2\text{Si}_{0.30}\text{Sn}_{0.67}\text{Bi}_{0.03}$ + 3.0 wt-% SiC	3.18	98	0.545

Equation S1. Hashin model¹.

$$E_c = E_m \left(\frac{E_m V_m + E_r \{V_r + 1\}}{E_r V_m + E_m \{V_r + 1\}} \right),$$

where, E_c is Young's modulus of the composite, E_m is Young's modulus of the matrix, E_r is Young's modulus of the reinforcing phase (E_r equals to 440 GPa)², V_m is volume fraction of the matrix, and V_r is volume fraction of the reinforcing phase (here: SiC).

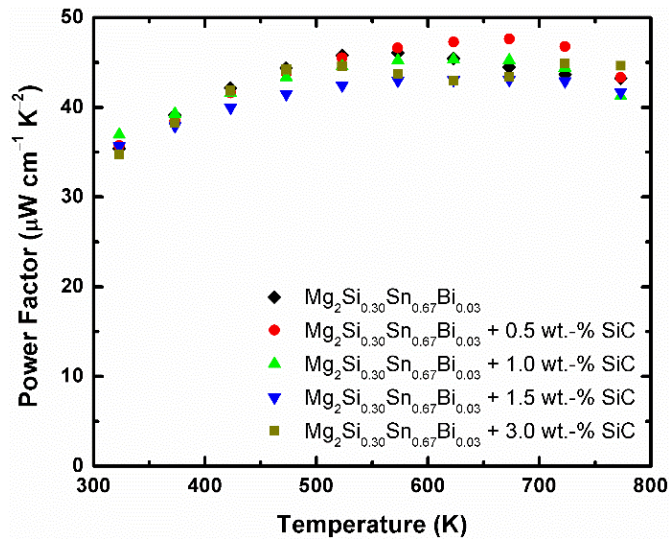


Figure S1. Power factor of $\text{Mg}_2\text{Si}_{0.30}\text{Sn}_{0.67}\text{Bi}_{0.03}$ composites with 0, 0.5, 1.0, 1.5, and 3.0 wt.-% of SiC.

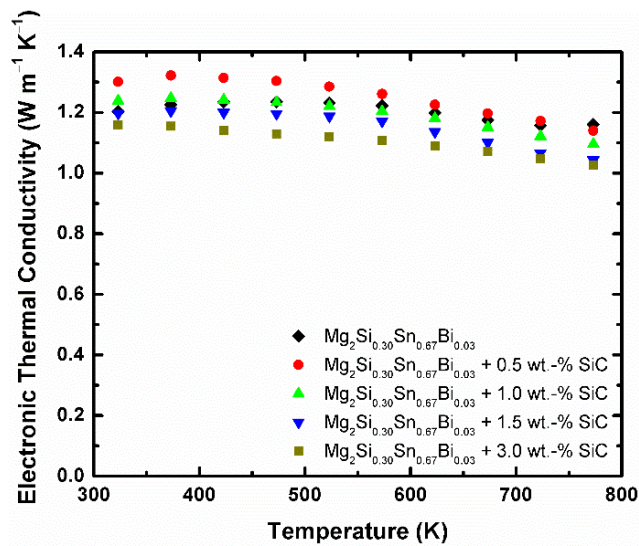


Figure S2. Calculated electronic thermal conductivity of $\text{Mg}_2\text{Si}_{0.30}\text{Sn}_{0.67}\text{Bi}_{0.03}$ composites with 0, 0.5, 1.0, 1.5, and 3.0 wt.-% of SiC.

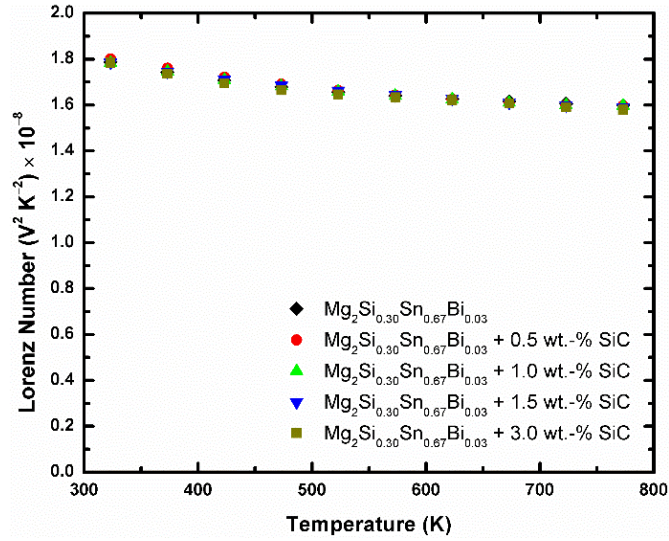


Figure S3. Calculated Lorenz numbers between 300 K and 800 K of $\text{Mg}_2\text{Si}_{0.30}\text{Sn}_{0.67}\text{Bi}_{0.03}$ composites with 0, 0.5, 1.0, 1.5, and 3.0 wt.-% of SiC.

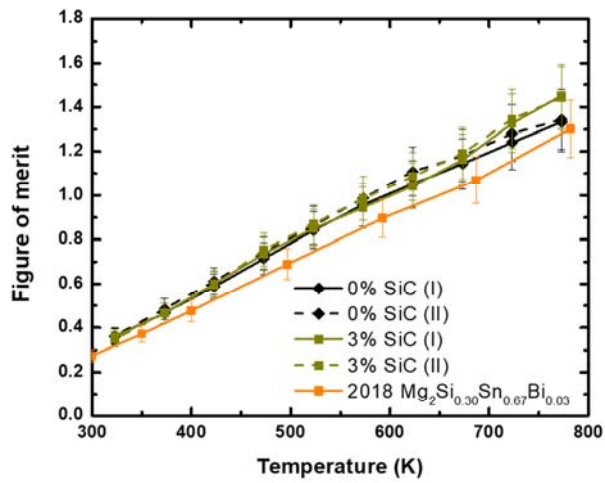


Figure S4. Figure of merit values from the two different pellets of $\text{Mg}_2\text{Si}_{0.30}\text{Sn}_{0.67}\text{Bi}_{0.03}$ (black symbols); $\text{Mg}_2\text{Si}_{0.30}\text{Sn}_{0.67}\text{Bi}_{0.03}/3.0$ wt.-% SiC composite (mustard symbols), compared to the 2018 data on $\text{Mg}_2\text{Si}_{0.30}\text{Sn}_{0.67}\text{Bi}_{0.03}$ (orange symbol).

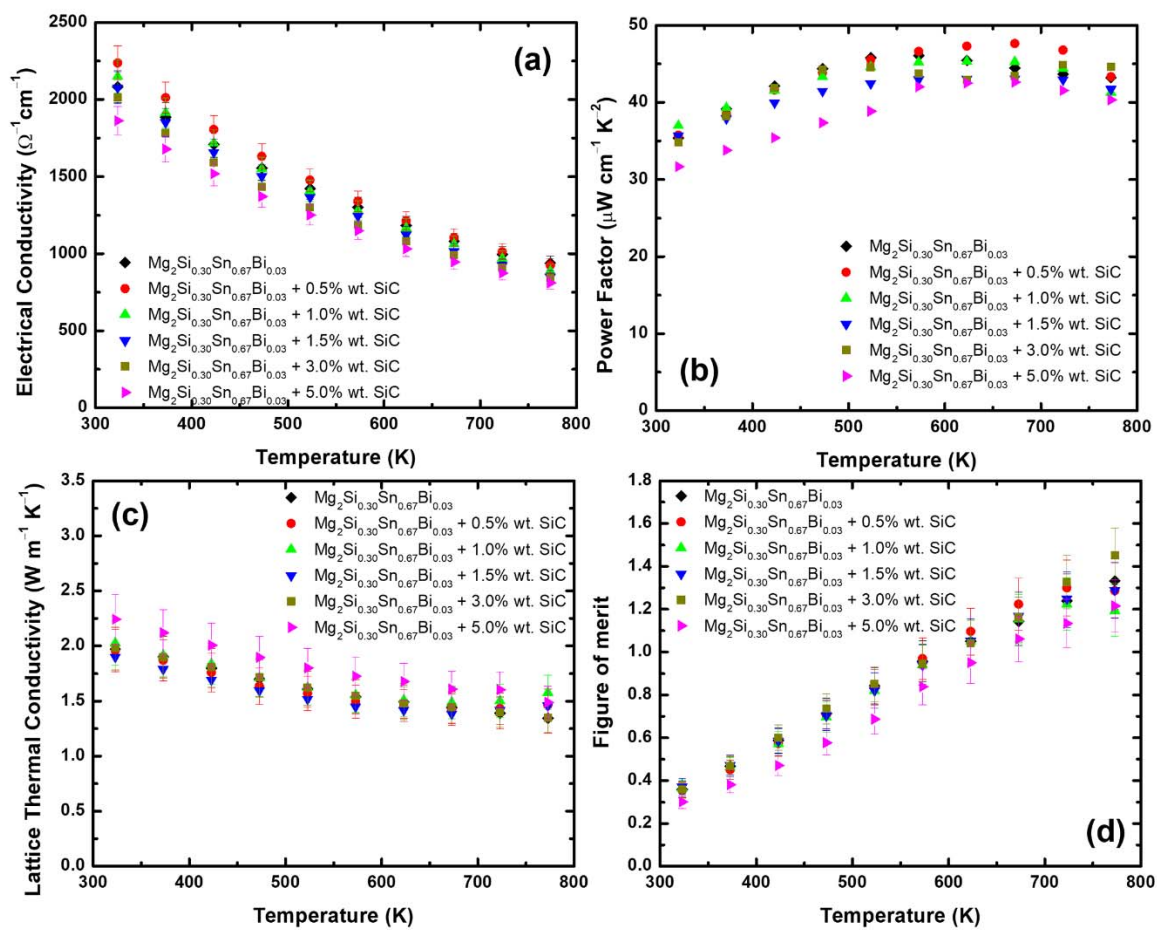


Figure S5. Electrical conductivity, power factor, lattice thermal diffusivity, and figure of merit of $\text{Mg}_2\text{Si}_{0.30}\text{Sn}_{0.67}\text{Bi}_{0.03}$ composites with 0, 0.5, 1.0, 1.5, 3.0, and 5.0 wt.-% of SiC.

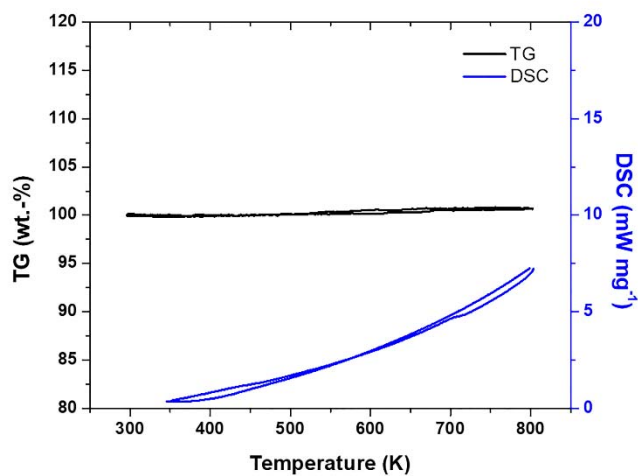


Figure S6. TG and DSC of $\text{Mg}_2\text{Si}_{0.3}\text{Sn}_{0.67}\text{Bi}_{0.03}$.

REFERENCES

- (1) Hashin, Z. The Elastic Moduli of Heterogeneous Materials. *J. Appl. Mech.* **1962**, 29 (1), 143–150.
- (2) Schreiber, E.; Soga, N. Elastic Constants of Silicon Carbide. *J. Am. Ceram. Soc.* **1966**, 49 (6), 342–342.