High Temperature Grain Boundary Resistance in $Yb_{14}(Mg,Mn)Sb_{11}$ Thermoelectrics

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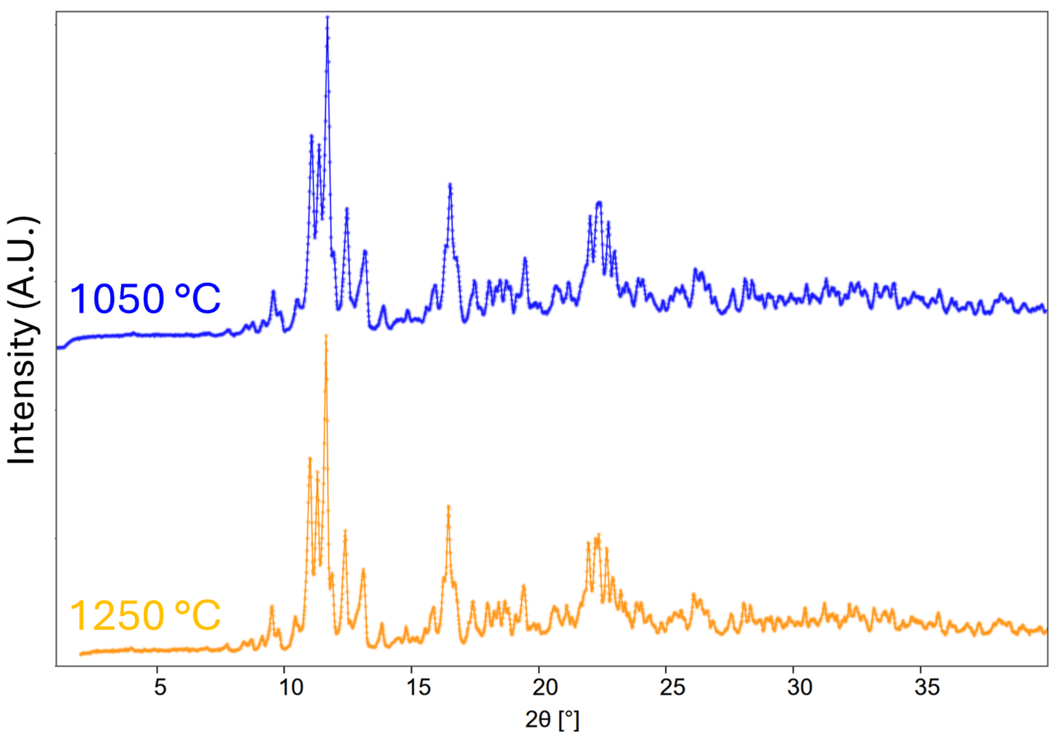
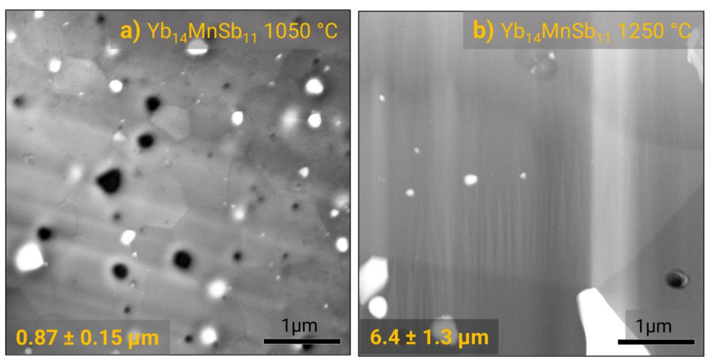
S1: Additional X-Ray Diffraction of the 1050°C and 1250°C Samples



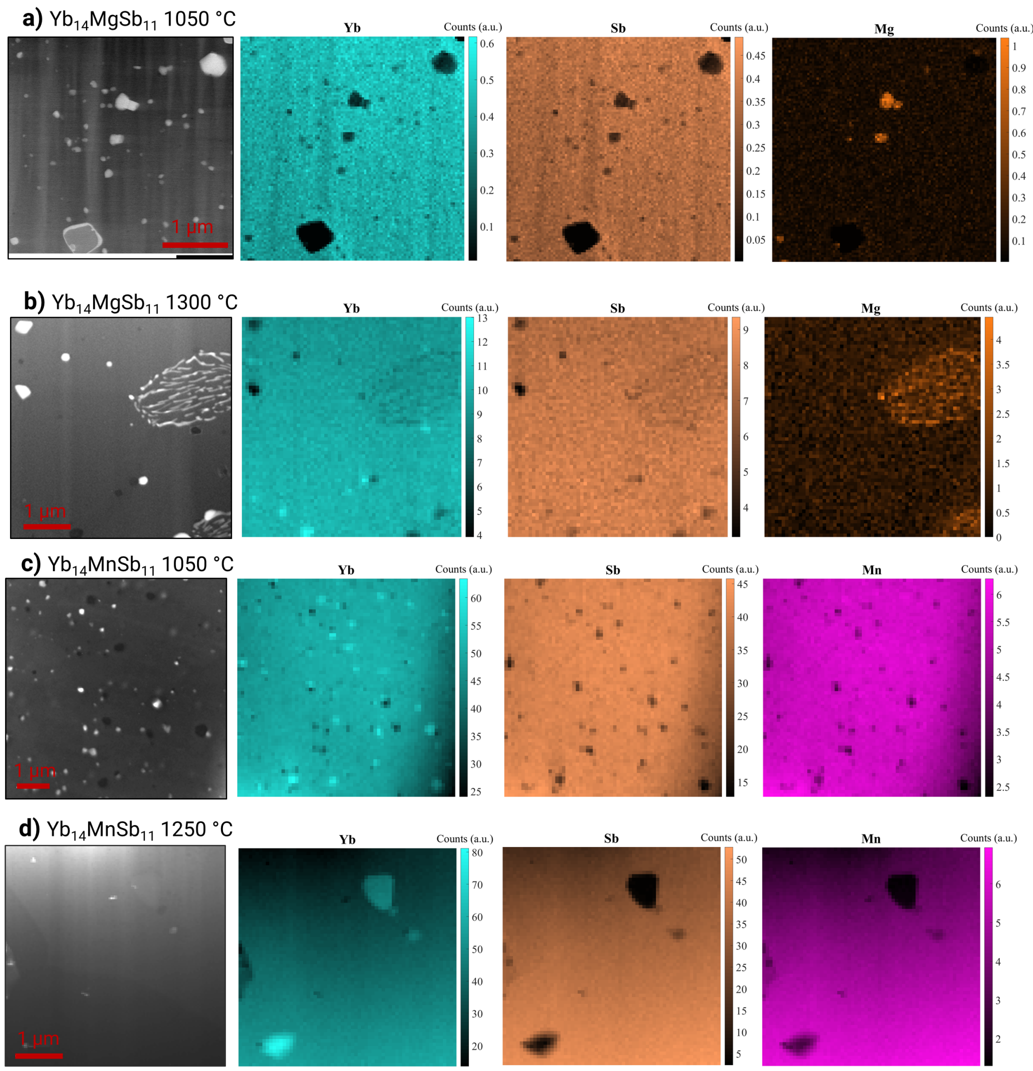
S2: Grain Size Measurement Details

sample	Mean Intercept Length Method					sample	Mean Intercept Length Method				
	Line	Line Length (µm)	Counts	mean intercept length (µm)	Grain Size (µm)		Line	Line Length (µm)	Counts	mean intercept length (µm)	Grain Size (µm)
$Yb_{14}MnSb_{11}$ 1050 C	1	3.368	6	0.5614	0.842	$Yb_{14}MgSb_{11}$ 1050 C	1	4.491	9	0.4990	0.749
	2	3.368	5	0.6737	1.011		2	4.491	9	0.4990	0.749
	3	3.368	5	0.6737	1.011		3	4.491	10	0.4491	0.674
	4	3.380	7	0.4828	0.724		4	4.491	12	0.3743	0.561
	5	3.380	5	0.6759	1.014		5	4.491	10	0.4491	0.674
	6	3.380	8	0.4224	0.634		6	4.491	10	0.4491	0.674
	Average				**0.872**		**Average**				**0.680**
	sdt				**0.152**		**sdt**				**0.063**
$Yb_{14}MnSb_{11}$ 1250 C	1	10.896	2	5.4480	8.172	$Yb_{14}MgSb_{11}$ 1250 C	1	6.892	9	0.7658	1.149
	2	10.896	3	3.6320	5.448		2	6.892	5	1.3784	2.068
	3	10.896	3	3.6320	5.448		3	6.892	5	1.3784	2.068
	4	10.896	2	5.4480	8.172		4	20.340	18	1.1300	1.695
	5	10.896	3	3.6320	5.448		5	13.534	14	0.9667	1.450
	6	10.896	3	3.6320	5.448		6	6.767	8	0.8459	1.269
	Average				**6.356**		**Average**				**1.616**
	sdt				**1.284**		**sdt**				**0.361**
						$Yb_{14}MgSb_{11}$ 1300 C	1	10.427	5	2.0854	3.128
							2	10.427	5	2.0854	3.128
							3	10.427	3	3.4757	5.214
							4	10.427	3	3.4757	5.214
							5	10.427	7	1.4896	2.234
							6	10.427	8	1.3034	1.955
							Average				**3.479**
							sdt				**1.300**

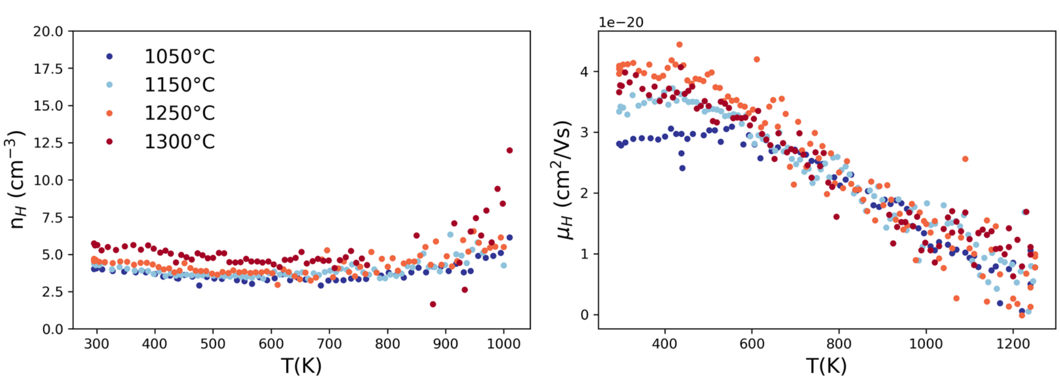
S3: $Yb_{14}MnSb_{11}$ Grain Size



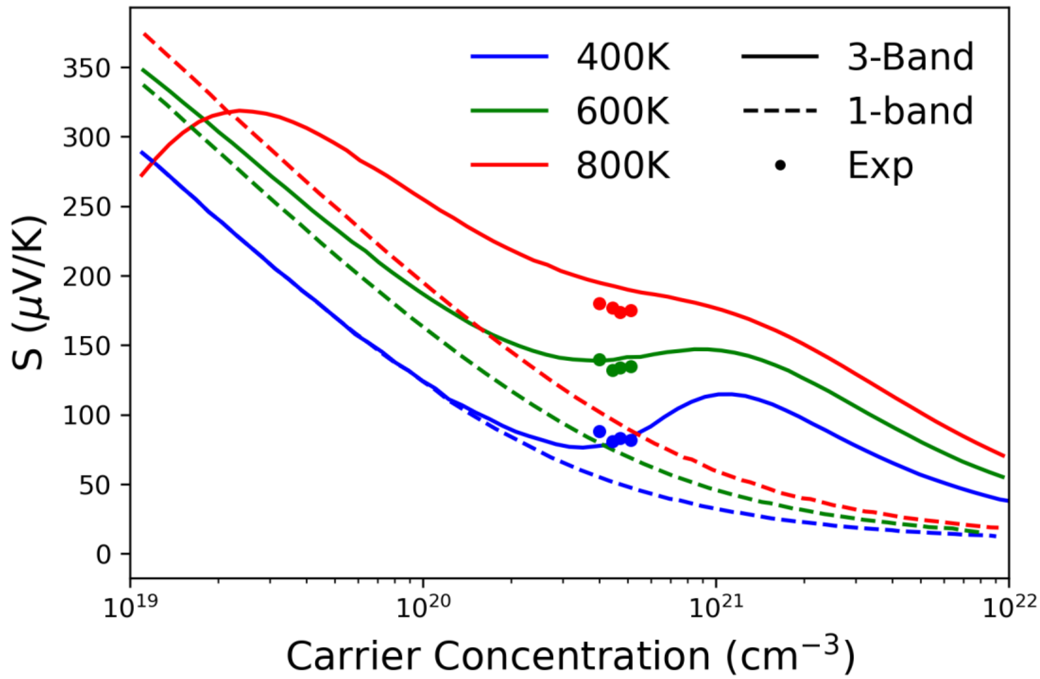
S4: Energy Dispersive X-Ray Spectroscopy



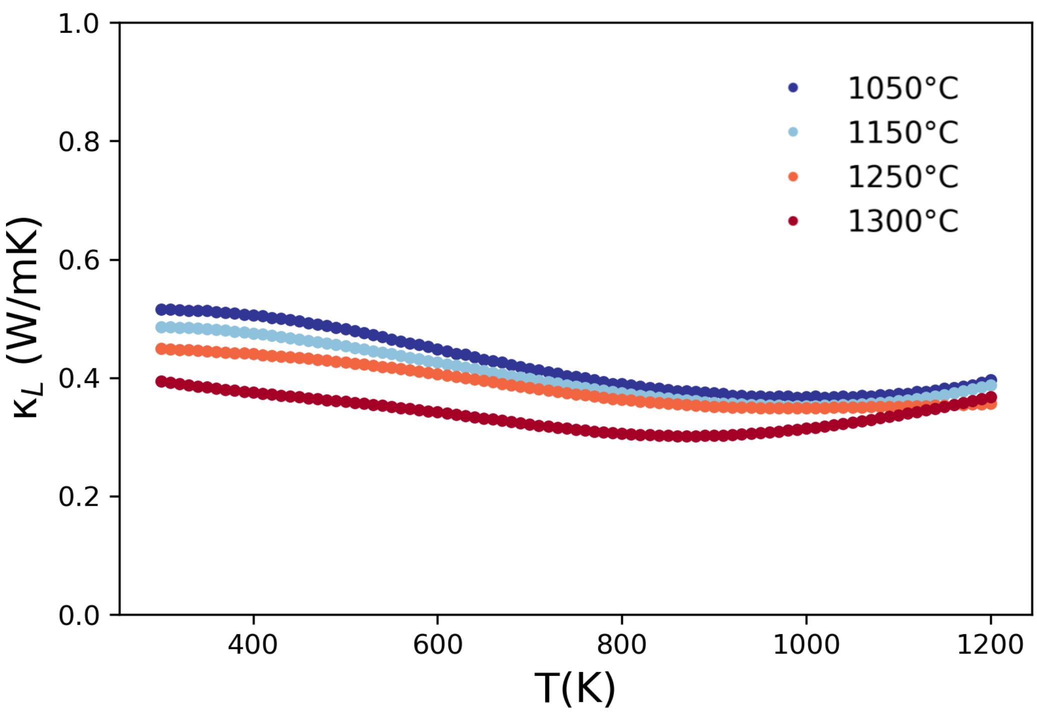
S5: Hall Carrier Concentration and Mobility in $Yb_{14}MgSb_{11}$



S6: Single and Multiband Pisarenko Plots for $Yb_{14}MgSb_{11}$

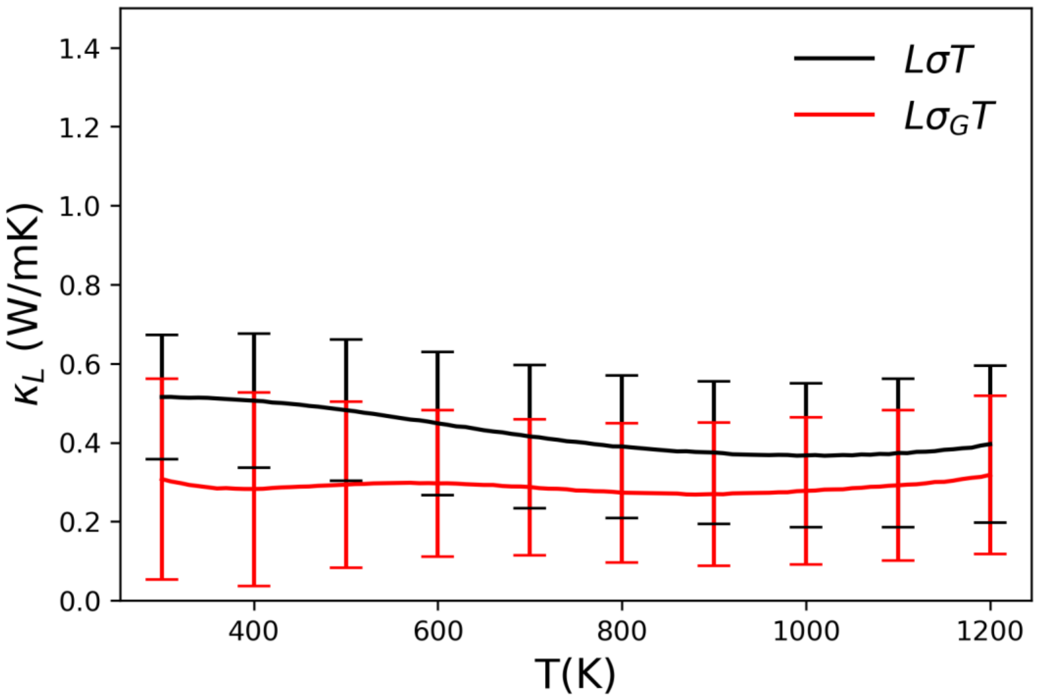


S7: Lattice Thermal Conductivity calculated with standard Wiedemann Franz Law



S8: Uncertainty in lattice thermal conductivity measurements

The error bars for κ_L were calculated using an uncertainty of 5% in Lorenz number,[1] 5% in electrical conductivity,[2] and 10% in measured thermal conductivity.[3] The uncertainty in the grain conductivity was calculated by taking the standard deviation in the x intercept in the ρ versus $1/d$ line from Equation 2 and Figure 7.



References

1. Kim, H.-S., Gibbs, Z. M., Tang, Y., Wang, H. & Snyder, G. J. Characterization of lorenz number with seebeck coefficient measurement. *APL Materials* **3**, 041506, DOI: 10.1063/1.4908244 (2015). https://pubs.aip.org/aip/apm/article-pdf/doi/10.1063/1.4908244/14557426/041506_1_online.pdf.

2. Borup, K. A. *et al.* Measuring thermoelectric transport properties of materials. *Energy Environ. Sci.* **8**, 423–435, DOI: 10.1039/C4EE01320D (2015).

3. Heremans, J. P. & Martin, J. Thermoelectric measurements. *Nat. Mater.* **23**, 18–19 (2024).