$PbBi_4Te_7$ and related compounds as new thermoelectric materials

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by

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$PbBi_4Te_7$ and related compounds

- $PbBi_4Te_7$ and related compounds
  - Several compounds known
  - MN_4Te_7 with M = Pb, Sn or Ge and N = Bi or Sb
  - Limited information about thermoelectric properties
    - Most infromation for $GeBi_4Te_7$
    - Small band semiconductor
- Crystal structure
  - Layered compounds ➔ anisotropy
  - Unit cell contains 12 layers ; example : Te Bi Te Bi Te Te Bi Te Pb Te
  - Hexagonal unit cell lattice parameters for $PbBi_4Te_7$: a =4.41 Å b = 72.09 Å
  - Bonding predominantly covalent within the 12 layered stacks
    - May give high carrier mobility
  - Van der Waals bonds between the 12 layered stacks
  - Octahedral coordination
    - Potential for lattice thermal conductivity
- Synthesis and characterization
  - Melting, quenching and annealing
  - X-ray and microprobe analysis
  - TE measurements

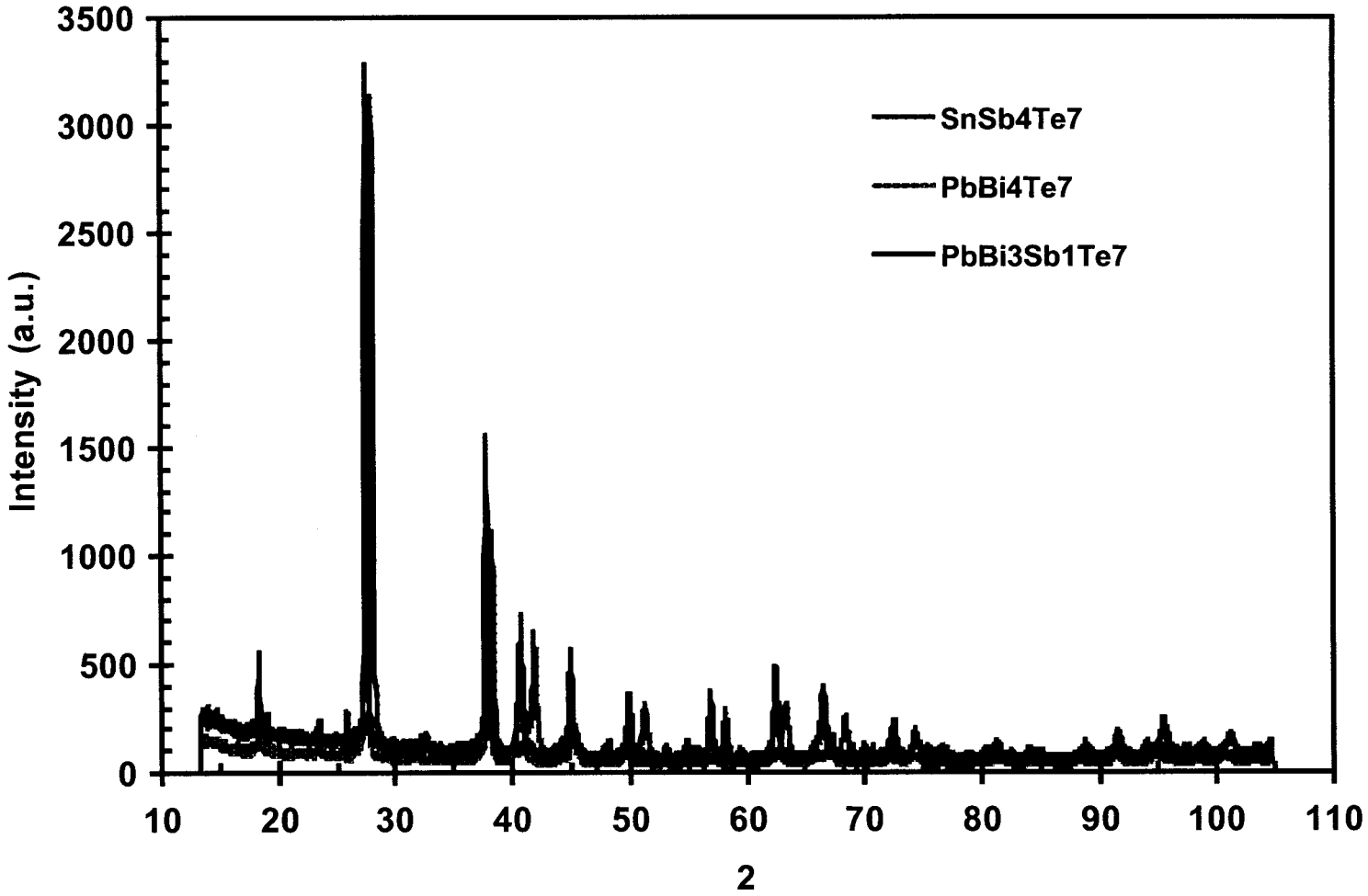
$PbBi_4Te_7$ and related compounds

Sample Label	Composition	cc_{300} cm^{-3}	μ_{H300} cm^2/Vs	ρ_{300} $m\Omega.cm$	S_{300} $\mu V/K$
DM63	$Sn_1Sb_4Te_7$				25.1
1DM63	cut per. pressing	9.63E+20	16.8	0.386	25.6
2DM63	cut par. pressing	8.65E+20	15.9	0.455	23.5
DM79	$Pb_{0.5}Sn_{0.5}Bi_2Sb_2Te_7$				119.0
	cut per. pressing	1.16E+20	30.3	1.772	107.0
	cut par. pressing	1.05E+20	21.3	2.780	104.0
DM81	$Pb_{0.5}Sn_{0.5}Bi_3Sb_1Te_7$				104.5
	cut per. pressing	1.13E+20	14.9	3.699	107.9
	cut par. pressing	8.71E+19	13.6	5.297	84.0

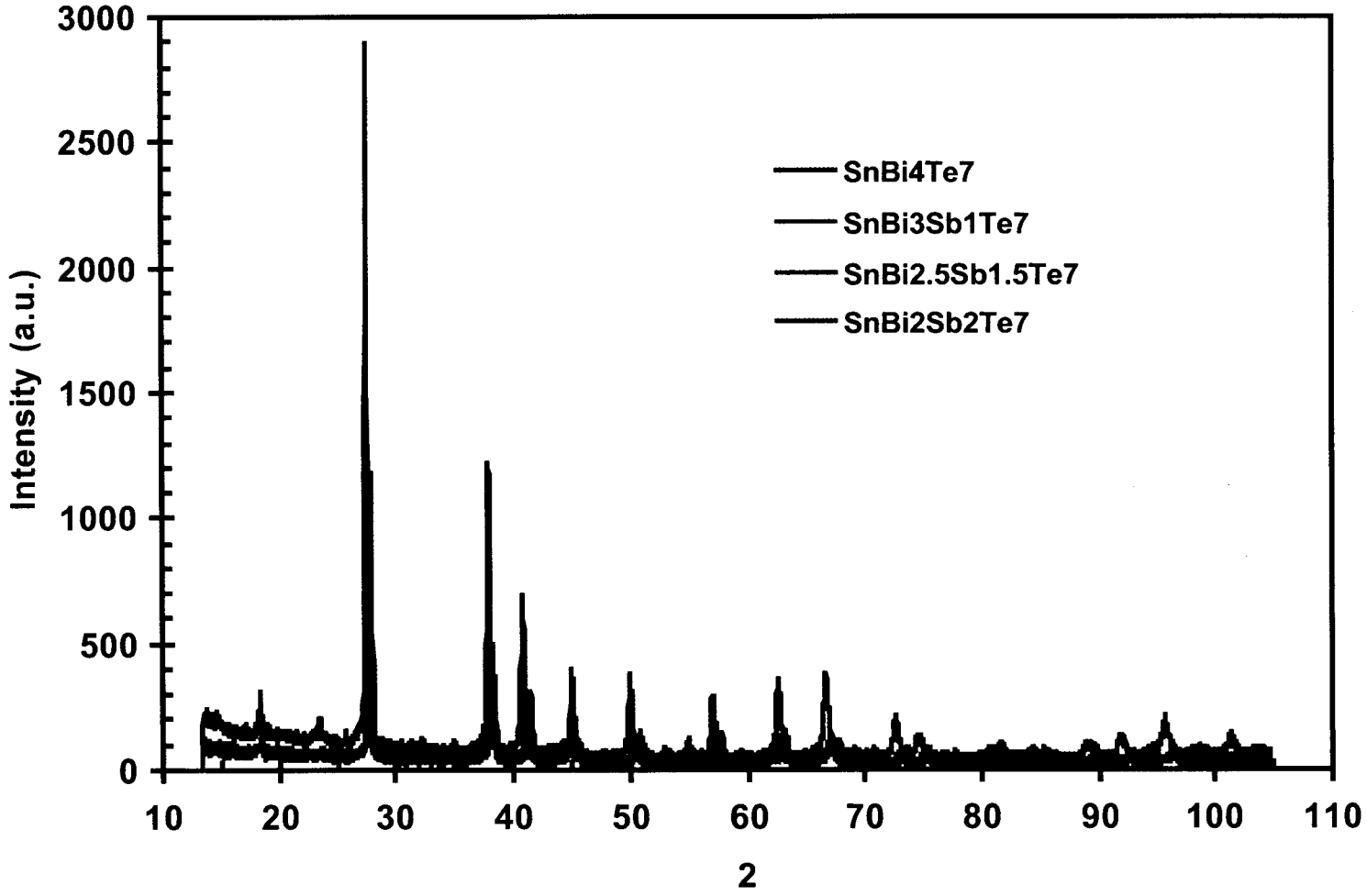
Sample Label	Composition	cc_{300} cm^{-3}	μ_{H300} cm^2/Vs	ρ_{300} $m\Omega.cm$	S_{300} $\mu V/K$
DM65	$Pb_1Bi_4Te_7$				-48.7
1DM65	cut per. pressing	2.72E+20	45.2	0.508	-53.4
2DM65	cut par. pressing	2.80E+20	36.5	0.612	-51.6
DM66	$Pb_1Bi_{3.5}Sb_{0.5}Te_7$				-76.2
1DM66	cut per. pressing	1.62E+20	48.2	0.802	-74.6
2DM66	cut par. pressing	1.57E+20	39.3	1.017	-73.9
DM71	$Pb_1Bi_3Sb_1Te_7$				-40.6
	cut per. pressing	1.06E+21	4.9	1.192	-38.6
	cut par. pressing	3.80E+21	1.0	1.662	-31.8
DM83	$Pb_1Bi_4Te_{6.3}Se_{0.7}$				-72.1
	cut per. pressing	1.65E+20	55.9	0.676	-76.2
	cut par. pressing	1.68E+20	41.1	0.906	-68.0

Sample Label	Composition	cc_{300} cm^{-3}	μ_{H300} cm^2/Vs	ρ_{300} $m\Omega.cm$	S_{300} $\mu V/K$
DM64	$Sn_1Bi_4Te_7$				95.4
1DM64	cut per. pressing	1.65E+20	13.3	2.843	102.3
2DM64	cut par. pressing	1.13E+20	14.9	3.710	90.3
DM76	$Sn_1Bi_3Sb_1Te_7$				97.7
	cut per. pressing	9.99E+19	28.9	2.166	120.3
	cut par. pressing	9.39E+19	17.9	3.720	118.4
DM77	$Sn_1Bi_{2.5}Sb_{1.5}Te_7$				99.3
	cut per. pressing	1.89E+20	30.5	1.083	94.7
	cut par. pressing	1.62E+20	28.3	1.360	90.2
DM78	$Sn_1Bi_2Sb_2Te_7$				74.6
	cut per. pressing	2.62E+20	29.2	0.818	71.8
	cut par. pressing	2.16E+20	25.9	1.120	66.5
DM85	$Sn_1Bi_4Te_{6.3}Se_{0.7}$				148.0
	cut per. pressing	1.10E+20	16.0	3.540	142.9
	cut par. pressing	7.97E+19	17.6	4.452	139.6

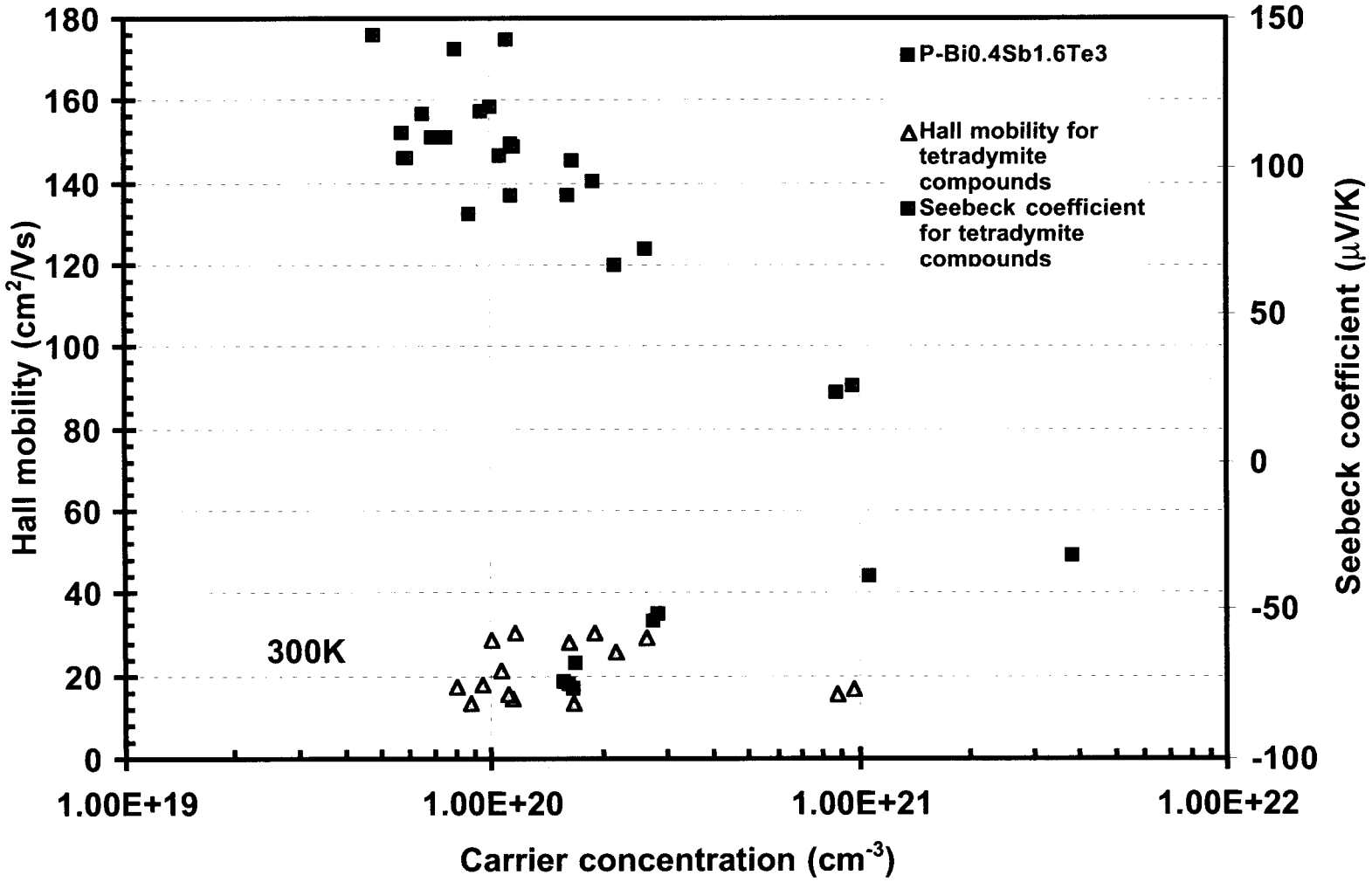
$PbBi_4Te_7$ and related compounds (continued)



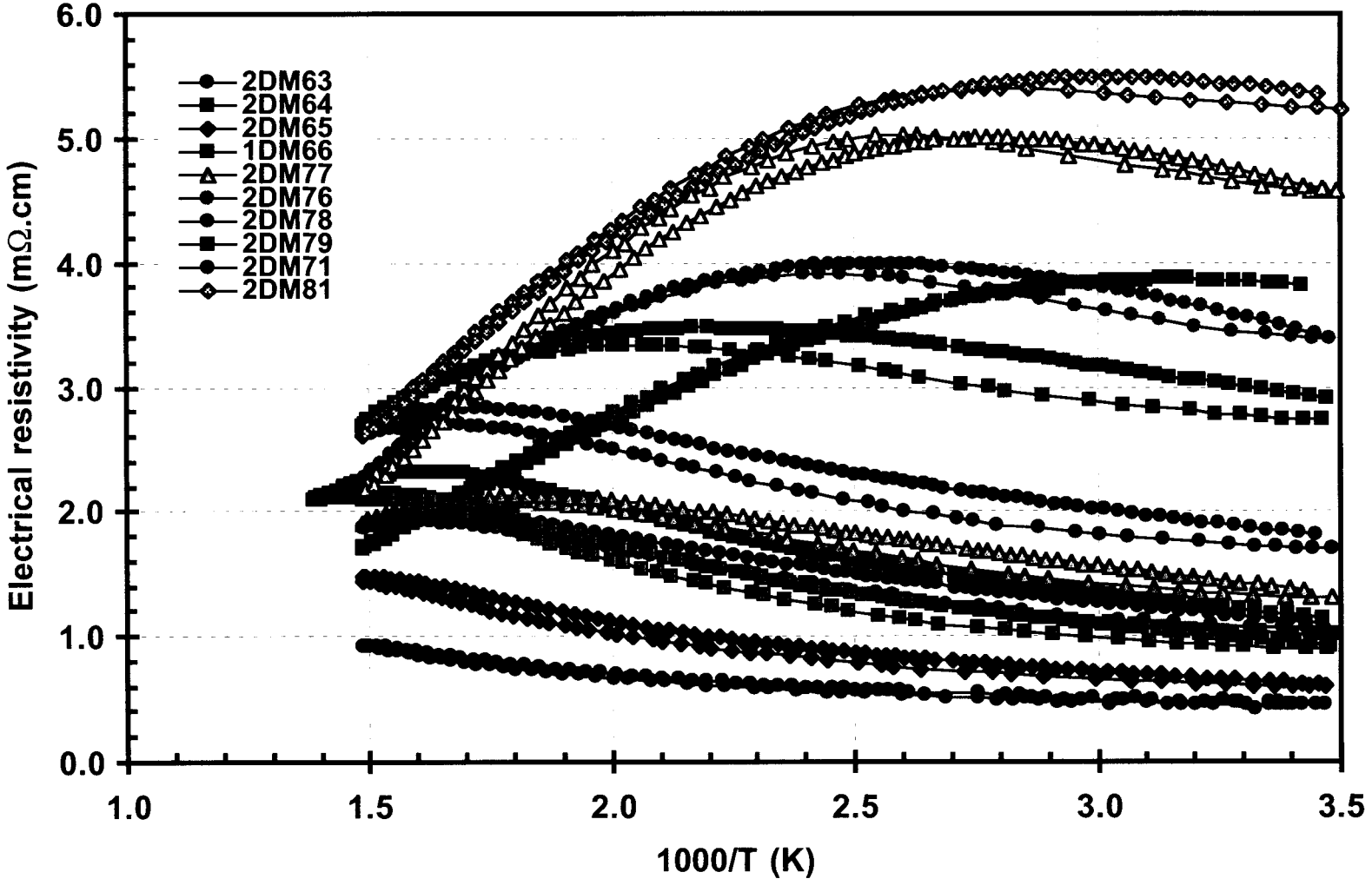
$PbBi_4Te_7$ and related compounds (continued)



$PbBi_4Te_7$ and related compounds (continued)



$PbBi_4Te_7$ and related compounds (continued)



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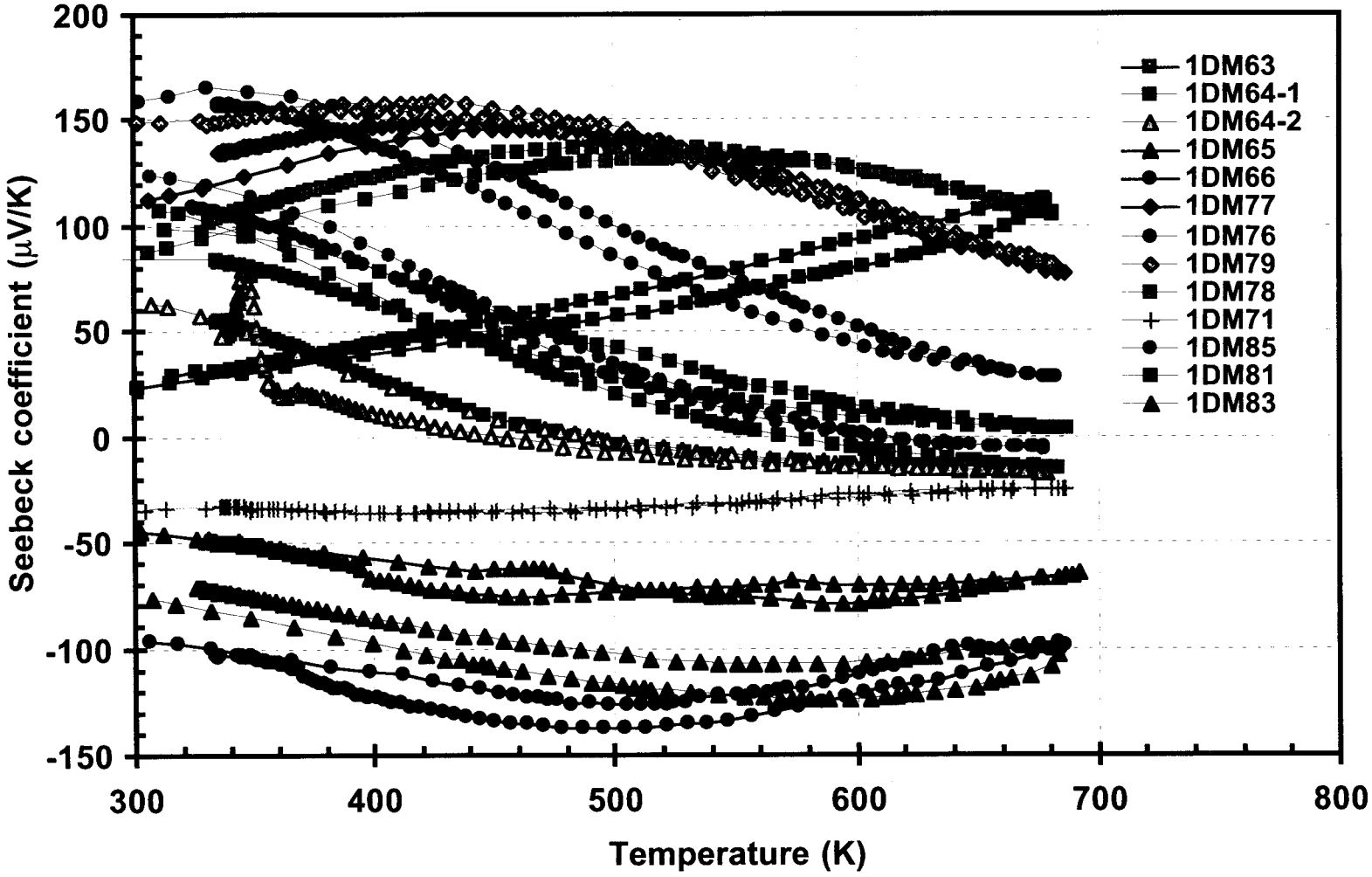
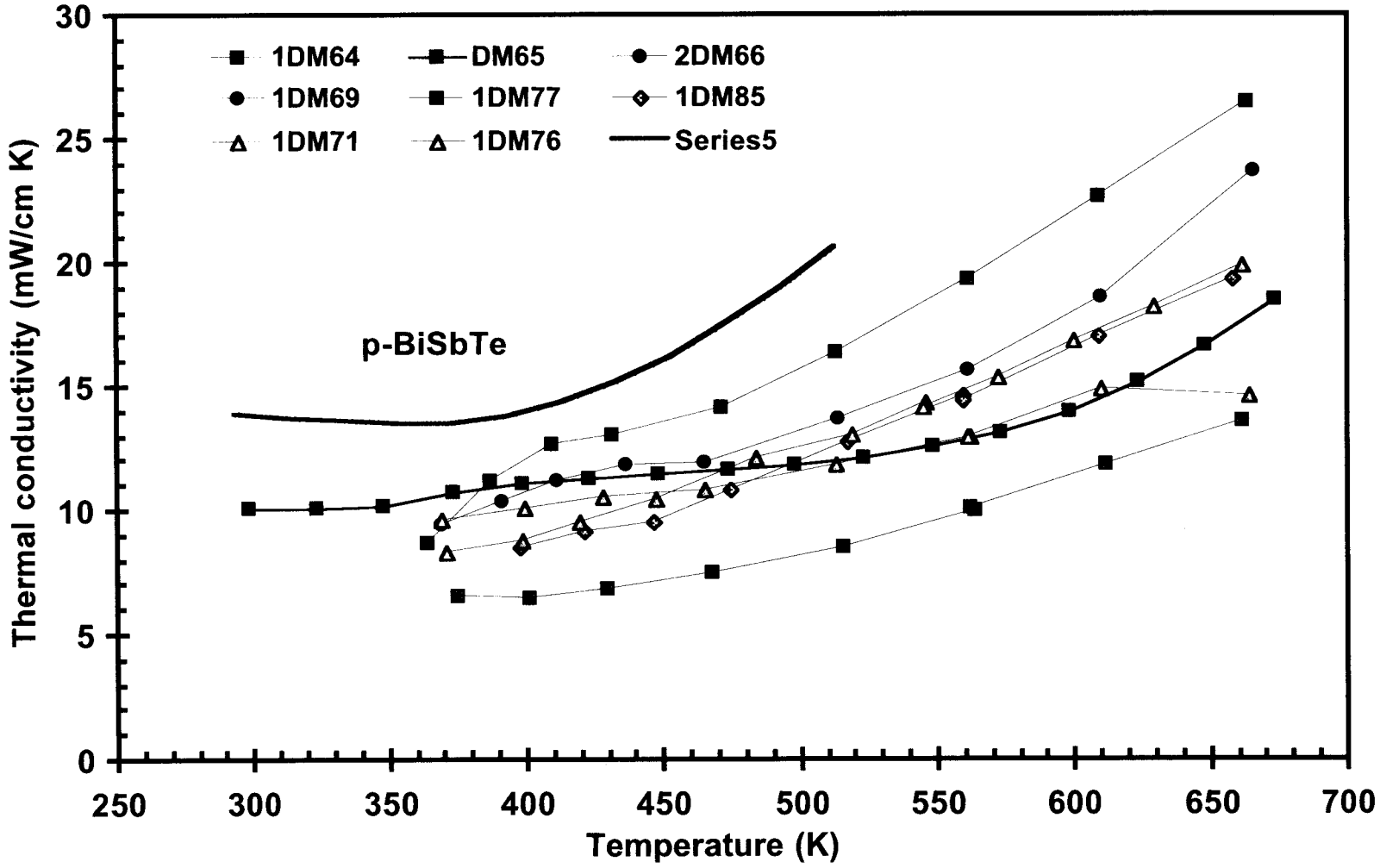
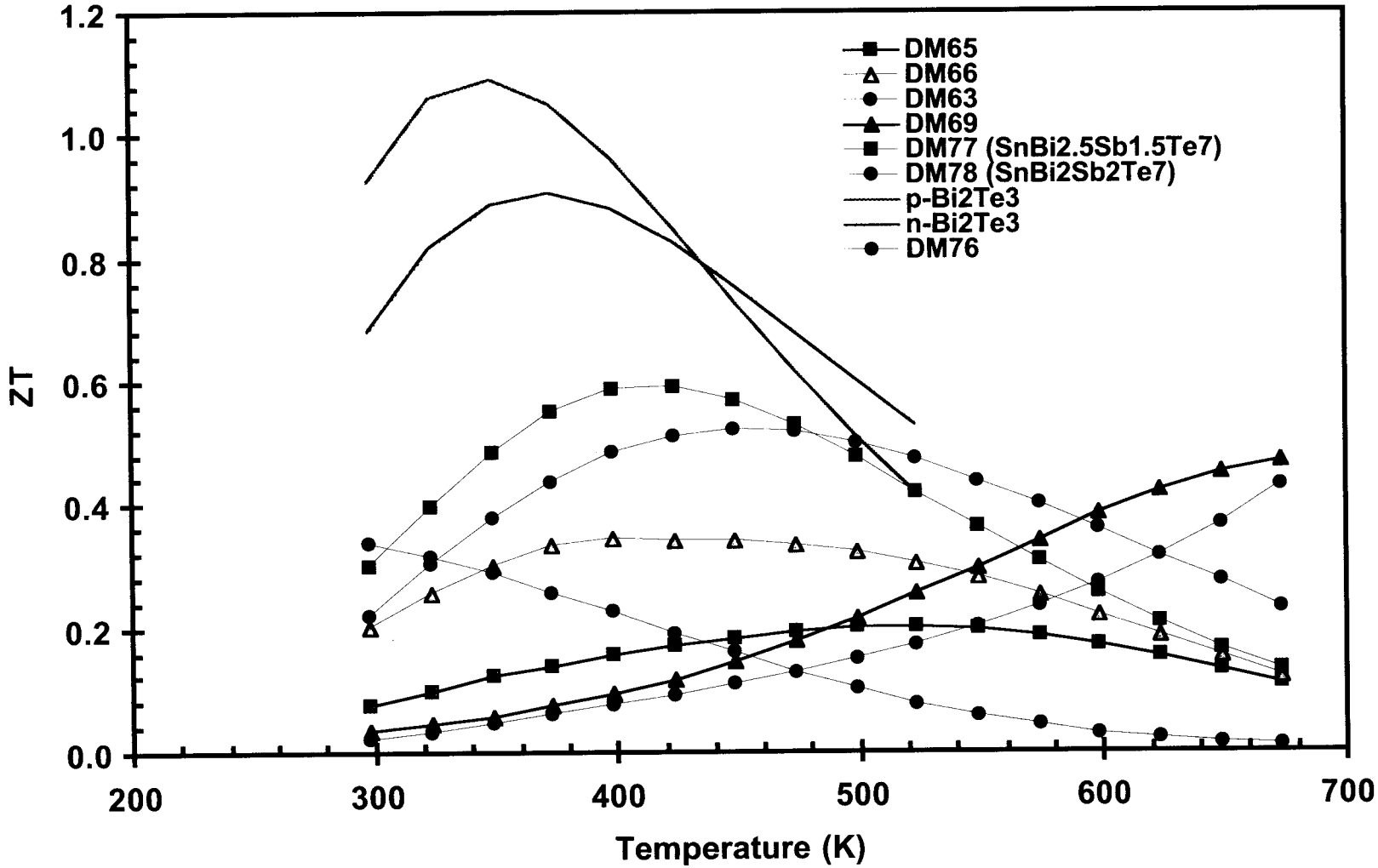


$PbBi_4Te_7$ and related compounds (continued)



$PbBi_4Te_7$ and related compounds (continued)