Electronic Supplementary Information

Low thermal conductivity and high figure of merit for rapidly synthesized n-type Pb$_{1-x}$Bi$_x$Te alloys

Tingting Chen$^1$, Hongchao Wang$^{1,2,*}$, Wenbin Su$^1$, Fahad Mehmood$^1$, Teng Wang$^1$
Jinze Zhai$^1$, Xue Wang$^1$, Chunlei Wang$^{1#}$

1. School of Physics, State Key Laboratory of Crystal Materials, Shandong University,
Jinan, China.

2. State Key Laboratory of Metastable Materials Science and Technology, Yanshan University, Qinhuangdao, China.

* E-mail: wanghc@sdu.edu.cn (H. Wang)

# E-mail: wangcl@sdu.edu.cn (C. Wang)
Figure S1. Distribution of grain size of Pb$_{1-x}$Bi$_x$Te nano-powders for (a) $x=0.00$, (b) $x=0.01$, (c) $x=0.02$, (d) $x=0.03$, and (e) $x=0.04$. 
Figure S2. Distribution of grain size of Pb$_{1-x}$Bi$_x$Te bulk alloys for (a) $x=0.00$, (b) $x=0.01$, (c) $x=0.02$, (d) $x=0.03$, and (e) $x=0.04$. 
Figure S3 The EDS mapping for Pb$_{1-x}$Bi$_x$Te nano-powders.
Figure S4 Temperature dependence of (a) the heat capacities derived from the equation of \( C_p \ (\text{k}_\text{B} \ \text{atom}) = 3.07 + 4.7 \times 10^{-4} \times (T/\text{K} - 300)^1 \), (b) the Lorenz numbers derived from the equation of \( L = 1.5 + \exp(-|S|/116)^2 \), (c) the thermal diffusivities, and (d) the electronic thermal conductivities for Pb\(_{1-x}\)Bi\(_x\)Te alloys.
Figure S5 Repeated measurements of (a) electrical resistivity, (b) Seebeck coefficient, (c) total thermal conductivity and (d) figure of merit for Pb$_{0.98}$Bi$_{0.02}$Te alloys.
Table S1. Experimental densities, theoretical densities and relative densities for Pb$_1$-$x$Bi$_x$Te alloys.

<table>
<thead>
<tr>
<th>Compositions</th>
<th>Experimental Density (g/cm$^3$)</th>
<th>Theoretical Density (g/cm$^3$)</th>
<th>Relative density (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>x=0.00</td>
<td>8.05</td>
<td>8.24</td>
<td>97.7</td>
</tr>
<tr>
<td>x=0.01</td>
<td>8.07</td>
<td>8.26</td>
<td>97.7</td>
</tr>
<tr>
<td>x=0.02</td>
<td>8.06</td>
<td>8.27</td>
<td>97.4</td>
</tr>
<tr>
<td>x=0.03</td>
<td>8.05</td>
<td>8.26</td>
<td>97.4</td>
</tr>
<tr>
<td>x=0.04</td>
<td>8.07</td>
<td>8.27</td>
<td>97.5</td>
</tr>
</tbody>
</table>
Table S2. The atom percentage of each element in Pb$_{1-x}$Bi$_x$Te nano-powders obtained from EDS results.

<table>
<thead>
<tr>
<th>Compositions</th>
<th>Pb (at%)</th>
<th>Te (at%)</th>
<th>Bi (at%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x=0.00$</td>
<td>50.8</td>
<td>49.2</td>
<td>0.0</td>
</tr>
<tr>
<td>$x=0.01$</td>
<td>50.4</td>
<td>48.8</td>
<td>0.8</td>
</tr>
<tr>
<td>$x=0.02$</td>
<td>49.7</td>
<td>48.5</td>
<td>1.7</td>
</tr>
<tr>
<td>$x=0.03$</td>
<td>50.6</td>
<td>47.5</td>
<td>1.9</td>
</tr>
<tr>
<td>$x=0.04$</td>
<td>49.8</td>
<td>48.3</td>
<td>1.9</td>
</tr>
</tbody>
</table>
Reference
