Nanoscale clusters in thermoelectric $AgPb_mSbTe_{m+2}$ and $(PbTe)_x(PbS)_{1-x}$ materials

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Introduction

$AgPb_mSbTe_{m+2}$ (high ZT [1]) and PbTe/PbS (very low lattice thermal conductivity [2]) show unusual thermoelectric properties.

HRTEM images (Fig. 1) showed that nanoclusters embedded in regular crystals are found in these systems.

Methods and Materials

Both $AgPb_mSbTe_{m+2}$ and PbTe/PbS are PbTe based materials.

We use atomic pair distribution method (PDF) to study these materials' local structure in nanoscale region [3].

Results

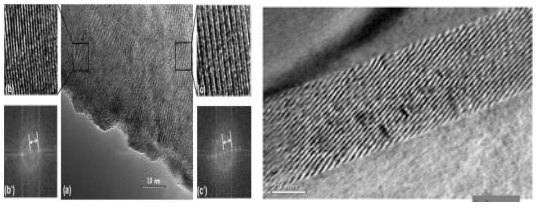
Nanoclusters with average chemical composition of $AgSbPb_2Te_4$ are found embedded in PbTe crystal in $AgPb_mSbTe_{m+2}$ system [4].

Phase separation was found occurring over the whole composition range of PbTe/PbS system. Multiscale phase separation is found in the PbTe84%-PbS16% sample.
Quenched PbTe50%-PbS50% sample appears to be in solid solution.

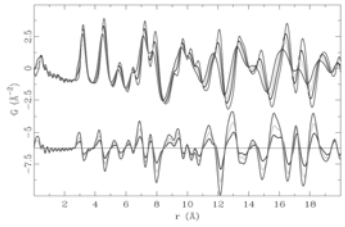
Discussion

Nanoclusters might be the reason why these materials have enhanced thermoelectric properties.

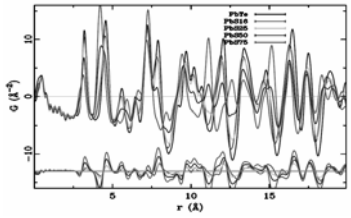
In PbTe/PbS system, length-scale of phase separation can be controlled by quenching rates. We propose that heat-treatment could be a good method for affecting TE ZT in these materials [6].



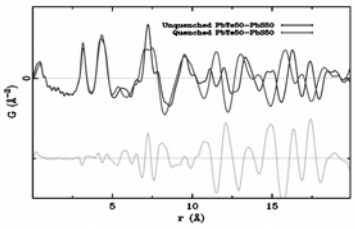
Fig。1: HRTEM for $Ag_{0.86}Pb_{18}SbTe_{20}$ [5] (left) and $PbTe_{0.84}S_{0.16}$ [2] (right) samples.



Fig。2: PDF for $AgPb_mSbTe_{m+2}$ [4] samples (m=0,6,12,18), the curves below are the differences to PbTe (m=0) sample.



Fig。3: PDF for PbTe/PbS samples, the curves below are the differences to PbTe sample.



Fig。4: Comparison of quenched and unquenched PbTe50%-PbS50% samples

Reference:

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[2] J. Androulakis, etc, to be submitted.
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