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ABSTRACT

A composite material comprises a filled skutterudite matrix of formula (I)

$$I_yCo_4Sb_{12} \qquad (I)$$

in which I represents at least one of Yb, Eu, Ce, La, Nd, Ba and Sr, $0.05 \leq y < 1$; and GaSb particles within the filled skutterudite matrix, wherein the composite material comprises 0.05-5mol% GaSb particles. Compared with conventional materials, the composite material exhibits a substantially increased Seebeck coefficient, a slightly decreased overall thermal conductivity, and a substantially increased thermoelectric performance index across the whole temperature zone from the low temperature end to the high temperature end, as well as a greatly enhanced thermoelectric efficiency.

India Reduced Claims

1. A composite material comprising:

a filled skutterudite matrix of formula (I)

$$I_yCo_4Sb_{12} \qquad (I)$$

wherein

I represents at least one of Yb, Eu, Ce, La, Nd, Ba and Sr,

$0.05 \leq y < 1$; and

GaSb particles within said filled skutterudite matrix, wherein said composite material comprises 0.05-5mol% GaSb particles.

2. The material of claim 1, wherein said GaSb particles are GaSb nanoparticles.

3. The material of claim 1, wherein said GaSb particles are distributed intragranularly in the crystalline granules of said filled skutterudite matrix, or intergranular on the crystalline boundaries of said filled skutterudite matrix, or both.

4. The material of claim 1, wherein I is Ce, Ba or a combination thereof.

5. The material of claim 1, wherein said composite material comprises 0.1-2.0 mol% GaSb particles.

6. A process for preparing the composite material of claim 1, comprising:

providing a molten mixture of I, Co, Sb and Ga, wherein I represents at least one of Yb, Eu, Ce, La, Nd, Ba and Sr,

quenching said molten mixture to form a solid bulk material;

annealing said solid bulk material to provide an annealed solid bulk material;

forming said annealed solid bulk material into powder;

consolidating said powder to form said composite material.

7. The process of claim 6, wherein said powder is sintered by a pressure sintering technique to form said composite material.

8. The process of claim 7, wherein said powder is sintered by hot pressed sintering technique or spark plasma sintering technique to form said composite material.

9. A process for increasing the ZT value of a thermoelectric material comprising a filled skutterudite matrix of formula (I)

$$I_yCo_4Sb_{12} \qquad (I)$$

wherein

I represents at least one of Yb, Eu, Ce, La, Nd, Ba and Sr,

$0.05 \leq y < 1$,

wherein said process comprises:

forming GaSb particles within said filled skutterudite matrix to provide a composite material of said filled skutterudite matrix and said GaSb particles comprising 0.05-5mol% of GaSb particles.

10. A process for preparing a material comprising the filled skutterudite matrix of formula (I)

$$I_yCo_4Sb_{12} \qquad (I)$$

wherein

I represents at least one of Yb, Eu, Ce, La, Nd, Ba and Sr,

$0.05 \leq y < 1$,

wherein said process comprises:

forming GaSb particles in said filled skutterudite matrix to provide a composite material of said filled skutterudite matrix and said GaSb particles comprising 0.05-5 mol% of GaSb particles.

Dated this 19/04/2012

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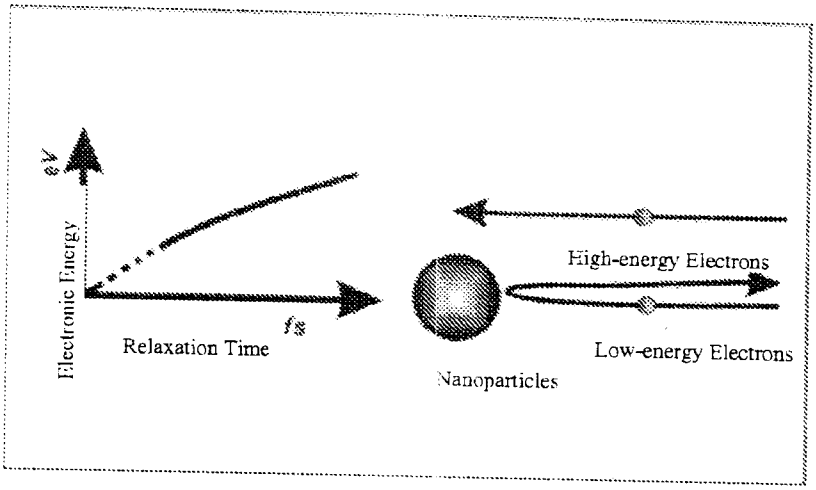

Fig. 1

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Fig. 2

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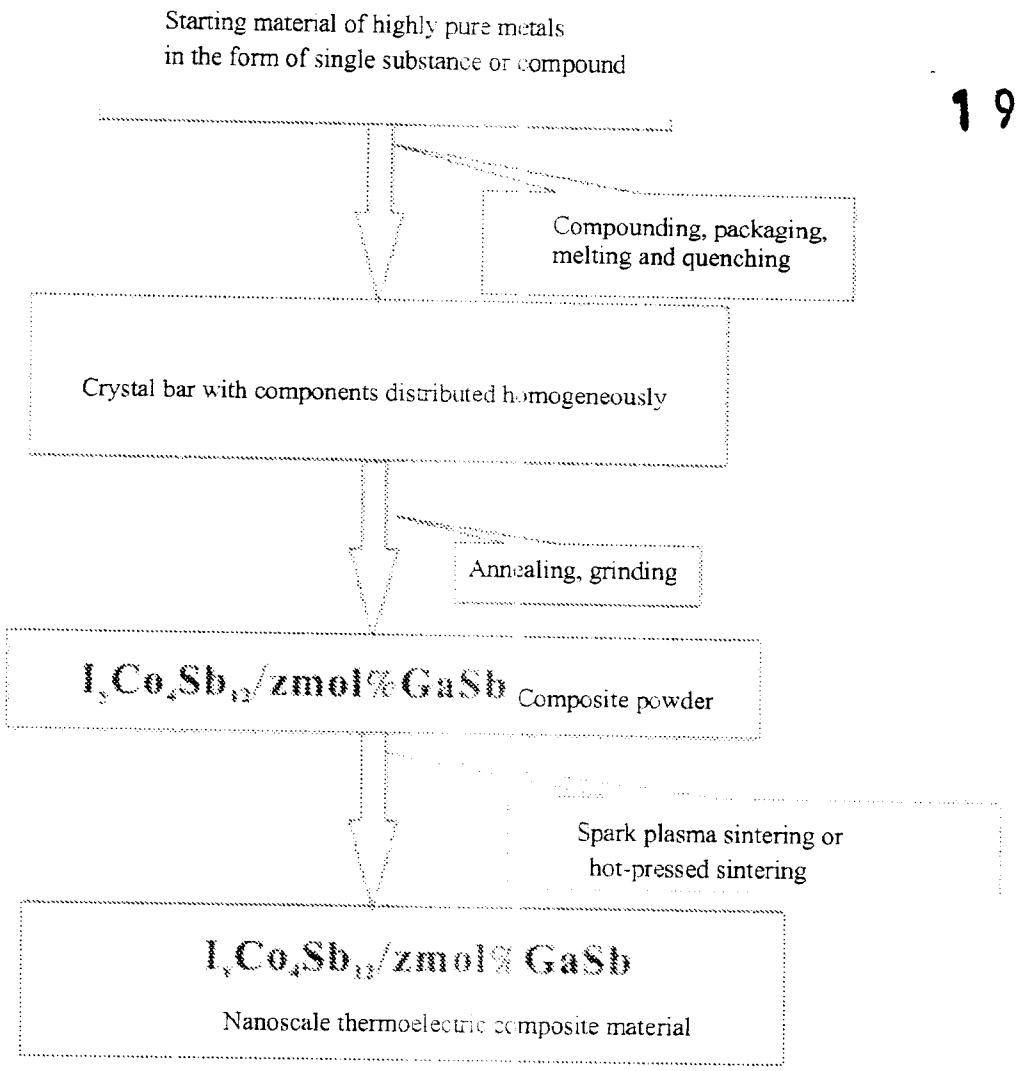

Fig. 3

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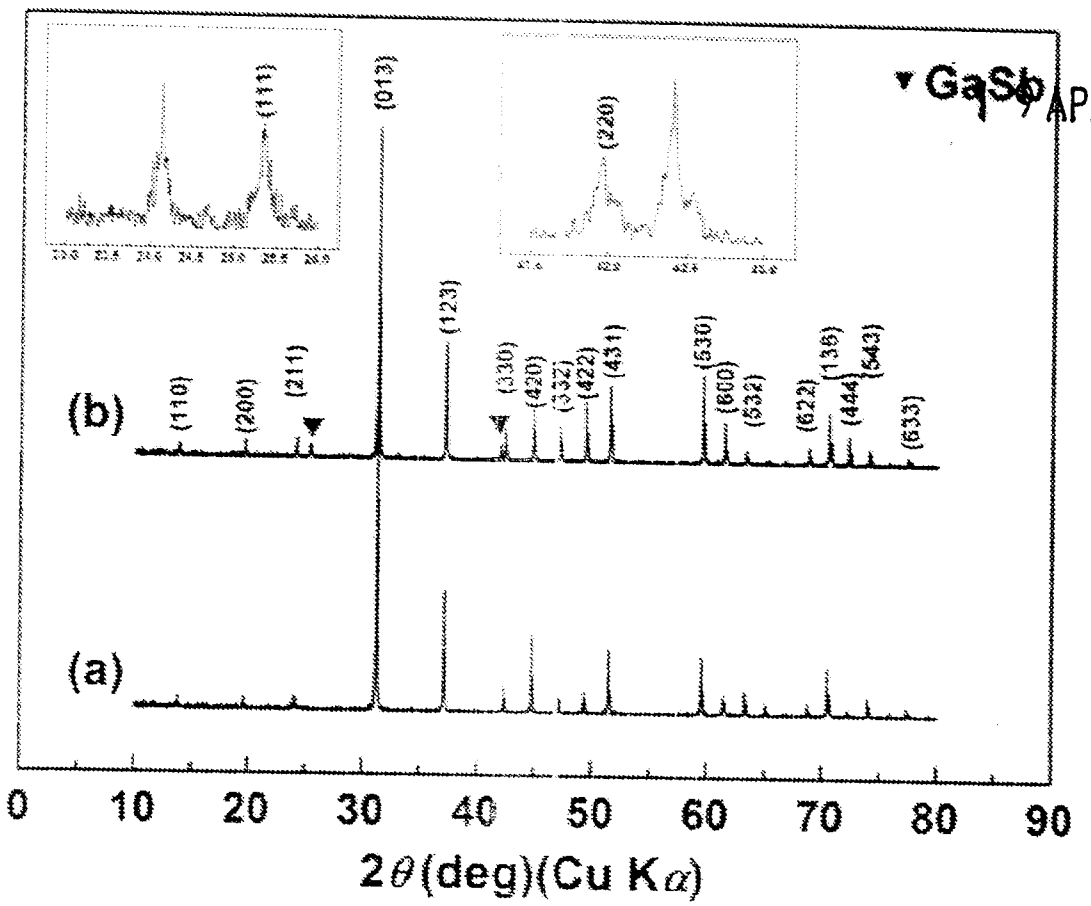

Fig. 4

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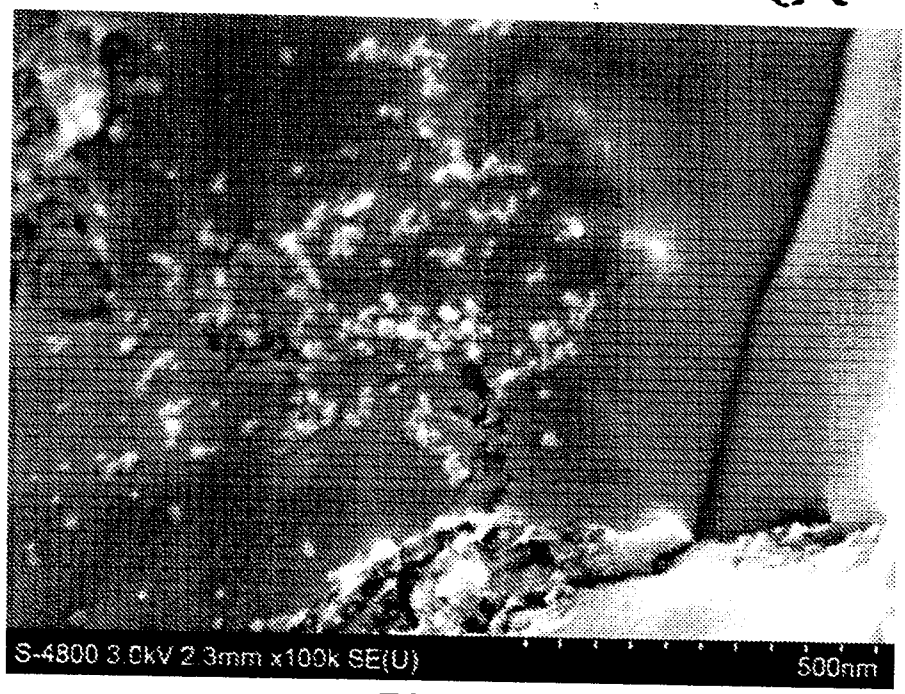

Fig. 5

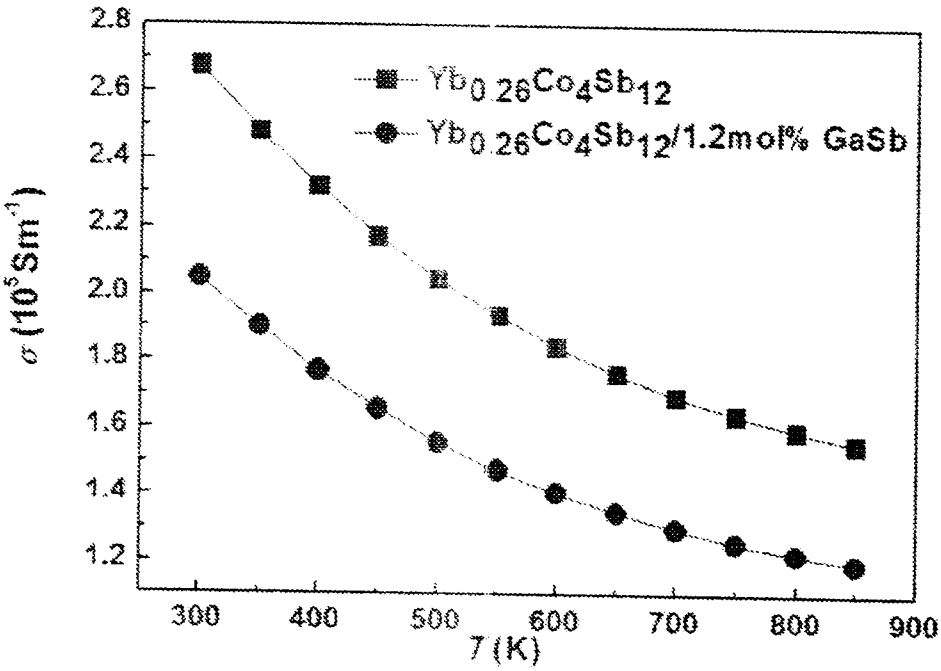

Fig. 6

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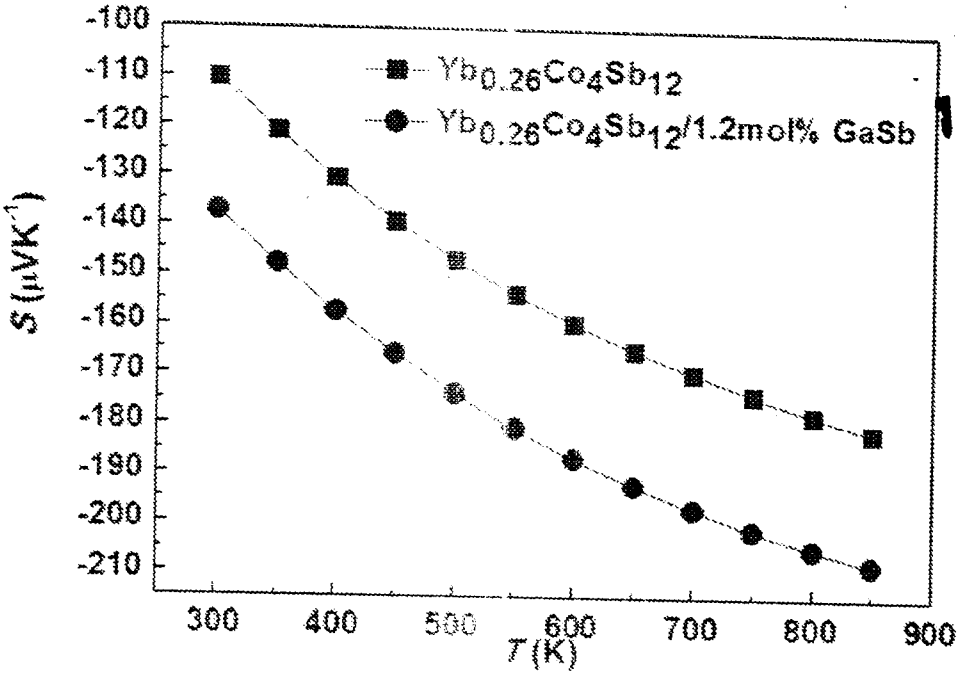

Fig. 7

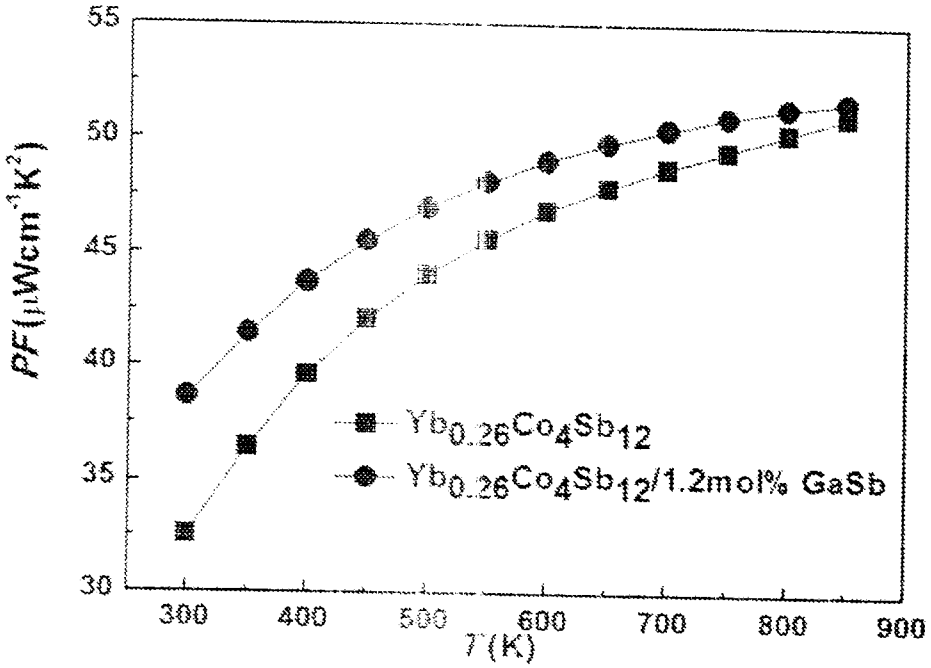

Fig. 8

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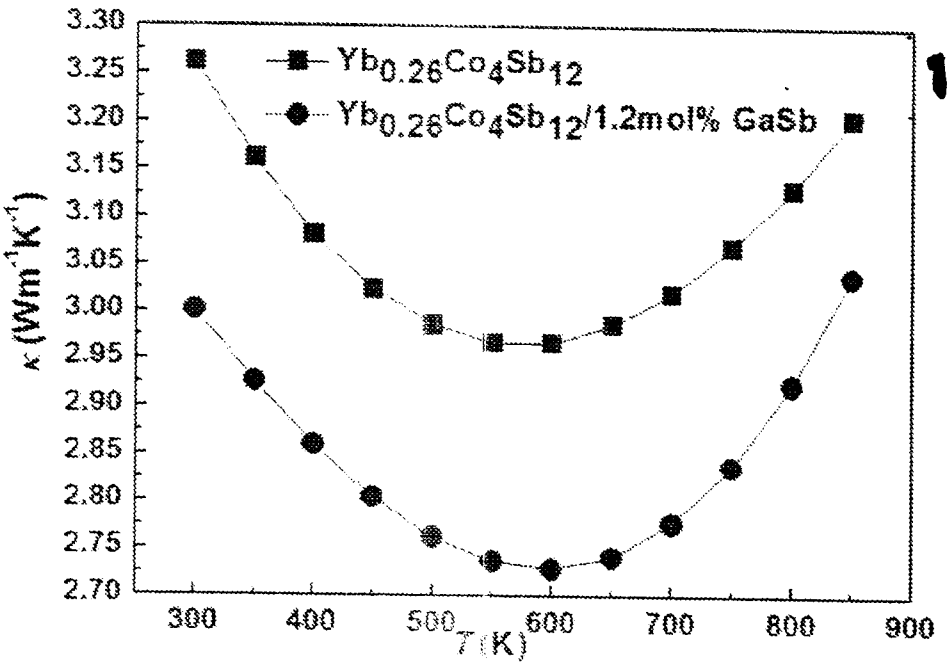

Fig. 9

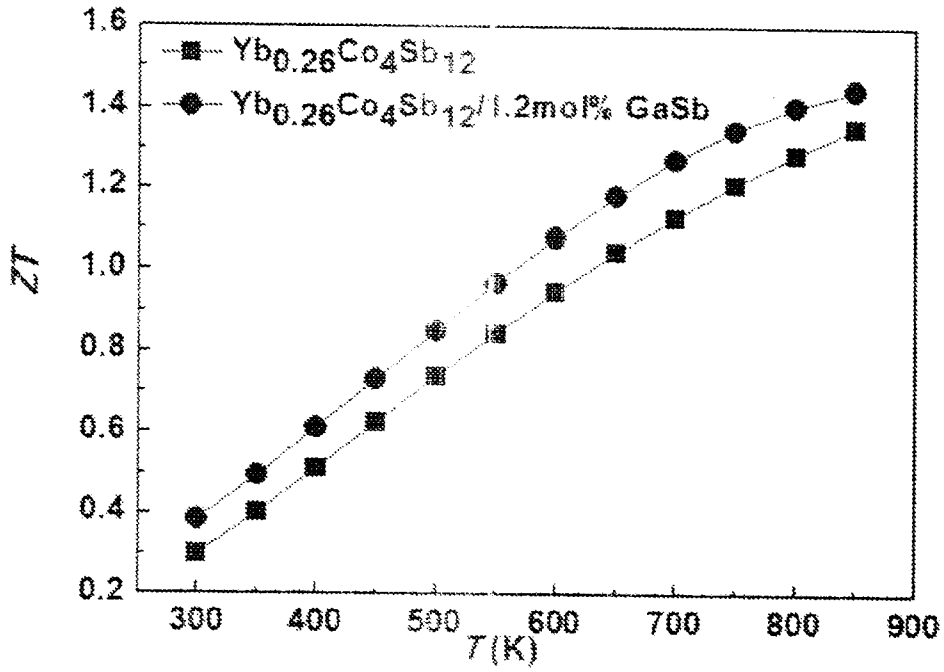

Fig. 10

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