

超高濃度ホウ素ドーピングSiGeによる巨大熱超電力の発現とその応用

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2005 Fiscal Year Final Research Report Summary

Generation of Giant Thermo-electric Power by Ultra-heavily Boron Doped SiGe and Its Application

Research Project

Project/Area Number

15360161

Research Category

Grant-in-Aid for Scientific Research (B)

Allocation Type

Single-year Grants

Section

一般

Research Field

Electronic materials/Electric materials

Research Institution

Kanazawa University

Principal Investigator

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Project Period (FY)

2003 - 2005

Keywords

Thermo-electric Effect / SiGe / Strain / Epitaxial Growth / Power Factor / Seebeck coefficient / Crystalline Defect / ZT

Research Abstract

Crystallinity :

Crystalline growth of SiGe films was slightly observed to take place at 400°C from XRD measurement. Below that the films were amorphous structure. The films were confirmed epitaxially grown from RHEED observation. Above 500°C, crystallinity was improved.

Resistivity :

Until 400°C, film resistivity decreased with increasing growth temperature but above that, resistivity was increased again. This phenomena is explained that at low temperature carrier is not generated because of the amorphous structure. While crystalline growth proceeds, carrier comes to be generated. Under almost perfect crystalline structure, however, resistivity increases again because of intrinsic semiconductor resulting in no carrier generation. The reason of low resistivity at 400°C is considered that appropriate crystalline defects generated carriers, which could conduct within the crystallized region.

Seebeck coefficient :

SiGe films prepared showed large Seebeck coefficients of 1.5-2.0mV/K which is more than 3 times larger than that of bulk SiGe. No special correlation was observed on Seebeck coefficient with samples.

Thermo-electric performances :

Power factor was estimated from the Seebeck coefficient and resistivity and showed as high as $7.2 \times 10^{-2} \text{Wm}^{-1} \text{K}^{-2}$. Moreover, the non-dimensional figure of merit Z reached $ZT=1.3$ at room temperature. This value shows useful for practical use.

Research Products (17 results)

	All	2006	2005	2004	2003	Other
	All	Journal Article	Book	Patent(Industrial Property Rights)		
[Journal Article] Crystallinity and strain control growth of SiGe using ion sputtering technique					2006	▼
[Journal Article] A novel magnetron sputtering for flexible coatings as a function for production of high quality films					2006	▼
[Journal Article] Crystallinity and strain control growth of SiGe using ion sputtering technique					2006	▼
[Journal Article] Future Textile					2006	▼
[Journal Article] Unbalanced Magnetron Sputtering using Cylindrical Target for Low-temperature Optical Costing					2005	▼
[Journal Article] A novel magnetron sputtering for flexible coatings as a function for production of high quality films					2005	▼
[Journal Article] 劣化エピタキシャル成長したSi-Ge系薄膜の熱電特性					2005	▼
[Journal Article] Unbalanced Magnetron Sputtering using Cylindrical Target for Low-temperature Optical Costing					2005	▼
[Journal Article] Thermo-electric Properties of Deteriorate Epitaxial Grown Si-Ge Based Thin Films					2005	▼
[Journal Article] Sputter Growth SiGe Films-Epitaxy, Strain and Thermo-electric Properties					2004	▼
[Journal Article] Sputtering Epitaxy of SiGe Films Using Mixture Target					2004	▼
[Journal Article] Thermoelectric Properties of Si/Ge Multi-nanolaye Films Prepared by Ion-beam Sputtering Technique					2004	▼
[Journal Article] Epitaxial Growth of SiGe Films Grown by Ion-Beam Sputtering and Generation of Large Thermoelectric Power					2004	▼
[Journal Article] Anomalous large thermoelectric power on heavily B-doped SiGe thin films with thermal annealing					2003	▼
[Journal Article] A novel magnetron sputtering for flexible coatings as a function for production of high quality films						▼
[Book] Future Textile					2006	▼
[Patent(Industrial Property Rights)] 傾斜材料とこれを用いた機能素子					2005	▼

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