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

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℃ from XRD measurement. Below that the films were amorphous structure. The films were confirmed epitaxially grown from RHEED observation. Above 500℃, crystallinity was improved.
Resistivity :
Until 400℃, 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 genneration. The reason of low resistivity at 400℃ 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 coreration was observed on Seebeck coefficient with samples.

Thermo-electric performances :
Power factor was estimated from the Seebeck coeffcient and resistivity and showed as high as 7.2x10^<-2>Wm^<-1>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 Texile 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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