Evaluation of Multilayer Structure by Using new High Sensitivity PAS

1991 Fiscal Year Final Research Report Summary

Evaluation of Multilayer Structure by Using new High Sensitivity PAS

Research Project

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01460074

Research Category

Grant-in-Aid for General Scientific Research (B)

Allocation Type

Single-year Grants

Research Field

Applied materials

Research Institution

Kanazawa University

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Keywords

Photoacoustic Spectroscopy / Multilayered structures / Piezoelectric transducer / Optical absorption coefficient / Ion implantation / GaInP / GaAs / LiNbO_3

Research Abstract

We developed a PAS (Photoacoustic Spectroscopy) using a transparent transducer. It is possible to evaluate an absorption coefficient of semiconductors quantitatively and to perform a reproducible experiment. As the light can irradiate through a transparent transducer, a generated acoustic slignal is directly detected by this transducer. Consequently, the sensitivity is considerably improved and there are no sample geometry limitations. Especially, this method is effective to evaluate the surface layer of the samples, ion implanted layers, interface of heteroepitaxial layers, and so on.
1. It is so sensitive that it is possible to detect the signals from the ion implanted layer. As this layer is so thin (900-3200, *) that this method is also applicable to evaluate the surface damages of semiconductors.
2. At low energy region we could detect a weak absorption which is generated by the localized states of ion implanted layer. By estimating this value, it is possible to evaluate the recovery process of the thin ion implanted layer by thermal annealing, quantitatively.
Next, PA signals from GaInP/GaAs heterostructure and multilayer structures of semiconductors were observed and the following results were obtained.

3. Each absorption edge of multilayer structure is determined separately by the PA dips and large phase shift.
4. Nonradiative defects are detected clearly at GaInP/GaAs interface.
5. The PA dip occurs at interfacial layer when the signal origin moves from one to another layer as irradiated wavelength changes. This is because the transducer detects two different phase signals with different amplitudes of each layer at the same time.
6. Now we are trying to separate the signals from piezoelectric and piroelectric effects and to make it possible to evaluate the optical and thermal constants quantitatively by comparing with the theoretical analysis.

Research Products (13 results)

All | Other

All | Publications (13 results)

[Publications] T.Hata,S.Adachi,S.Horita: "Evaluation of multilayer sturucture and depth profile by PAS using transparent transducer" Japan J.Appl.Phys. Suppl.28-1. 243-245 (1989)

[Publications] S.Horita,S.Yagi,T.Hata: "Consideration of PA signal of multylayer structure measured by PAS using transparent transducer" Japna J.Appl.Phys.29-1. 274-276 (1990)

[Publications] S.Horita,S.Yagi,T.Hata: "Theoretical analysis of photoacoustic signal on PAS using transparent transducer" Japna J.Appl.Phys.30-1. 286-288 (1991)

[Publications] S.Horita,E.Miyagoshi,M.Ishimaru,T.Hata: "Improvement of sensitivity of photothermal deflection spectroscopy by double PAS method" Rev.Sci.Instrum.1992. (1992)

[Publications] T.Hata,M.Ishimaru,S.Horita: "Optical and thermal evaluation of semiconductor by differential Photothermal Deflection Spectroscopy" Japan J.Appl.Phys.31-1. (1992)

[Publications] S.Horita,T.Saikawa,T.Hata: "Influence of piezoelectric and pyroelectric effects on photo acoustic signal of PAS using transparent transducer" Japan J.Appl.Phys.31-1. (1992-)

[Publications] 御子柴 宣夫他編,畑 朋延(担当分): "超音波スペクトロスコピ-[応用編]光音響分光法(畑担当分)" 培風館, 256(30) (1990)

[Publications] T. Hata, S. Adachi, and S. Horita: " "Evaluation of multilayer structure and depth profile by PAS using transparent transducer"" Japan J. Appl. Phys.Suppl. 28-1. 243-245 (1989)

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[Publications] S. Horita, S. Yagi and T. Hata: " "Theoretical analysis of photoacoustic signal on PAS using transparent transducer"" Japan J. Appl. Phys.Suppl. 30-1. 286-288 (1991)

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[Publications] T. Hata, M. Ishimaru and S. Horita: " "Optical and thermal evaluation of semiconductor by differential photothermal deflection spectroscopy"" Japan J. Appl. Phys.Suppl. 31-1. (1992)

[Publications] S. Horita, T. Saikawa and T. Hata: " "Influence of piezoelectric and pyroelectric effects on photoacoustic signal of PAS using a transparent transducer"" Japan J. Appl. Phys.Suppl. 31-1. (1992)

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