Preparation of photoluminescent nanosized si by pulsed laser ablation

1996 Fiscal Year Final Research Report Summary

PREPARATION OF PHOTOLUMINESCENT NANOSIZED Si BY PULSED LASER ABLATION

Research Project

Project/Area Number

07650008

Research Category

Grant-in-Aid for Scientific Research (C)

Allocation Type

Single-year Grants

Section

一般

Research Field

Applied materials science/Crystal engineering

Research Institution

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PULSED LASER ABLATION / NANOSIZED Si / PHOTOLUMINESCENCE / OXIDIZED Si MATRIX / XPS / RAMAN SCATTERING / X-RAY DIFFRACTION / X線回折

Research Abstract

A variety of silicon-based films with nanosized crystallite inclusions have been prepared for visible photoemission using various techniques. Pulsed laser ablation has been attracting much attention for preparation of high-quality perovskite oxide films. The preparation technique has a quite unique feature that depositing particles have a broad distribution in size from mono- or diatomic species to huge clusters, so called droplets, with a micron size. In this study, for preparation of inhomogeneous oxide film with silicon crystallite inclusions in silicon oxide matrix, the pulsed laser ablation was employed.
Silicon oxide films were prepared on fused quartz substrates at room temperature by pulsed laser ablation using silicon target and an ArF excimer laser with wavelength of 193 nm in a mixture of oxygen and helium gases. For depositing films the laser beam was focused into a small area resulting in 3.5 J/cm^2. After the deposition an ArF laser irradiation with 0.5 J/cm^2 was performed for enhancing photoluminescence. Photoluminescence, X-ray diffraction and Raman scattering measurements were performed. The photoluminescence measurement was carried out at room temperature using Ar- ion- laser excitation.
As- deposited films obtained by pulsed laser ablation was found to be transparent silicon oxides including silicon crystallites with size as large as tens of nm. These large crystallites above nanosize were not expected to be photoluminescent centers. In fact, the as- deposited film shows a very weak photoluminescence. However, after the laser irradiation of 1000 shots the photoluminescence intensity was dramatically increased by two orders of magnitude. The photoluminscence spectrum was centered around 550 nm in wavelength. This dramatic enhancement can be attributed to a formation of nanosized silicon crystallites or a reduction of the defect density.

Research Products (8 results)

All | Other

All | Publications (8 results)

[Publications] A.Masuda,et al.: "Ambient-Pressure Dependence on Droplets Formation and Thickness Distribution in Pulsed Laser Ablation" Materials Science and Engineering B. 41. 161-165 (1996)

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[Publications] T. Shimizu and A. Morimoto: "Extended Abstract of the 12th Yokohama Forum for the 21st Century on Fullerens and Laser Processing "Laser Ablation Deposition of Oxide Films"" Yokohama City University, 8 (1996)

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