Plasma-enhanced growth, composition, and refractive index of silicon oxy-nitride films -
DTU Orbit (09/04/2019)

Plasma-enhanced growth, composition, and refractive index of silicon oxy-nitride films
Secondary ion mass spectrometry and refractive index measurements have been carried out on silicon oxy-nitride produced by plasma-enhanced chemical vapor deposition (PECVD). Nitrous oxide and ammonia were added to a constant flow of 2% silane in nitrogen, to produce oxy-nitride films with atomic nitrogen concentrations between 2 and 10 at. %. A simple atomic valence model is found to describe both the measured atomic concentrations and published material compositions for silicon oxy-nitride produced by PECVD. A relation between the Si–N bond concentration and the refractive index is found. This relation suggest that the refractive index of oxy-nitride with a low nitrogen concentration is determined by the material density. It is suggested that the relative oxygen concentration in the gas flow is the major deposition characterization parameter, and that water vapor is the predominant reaction by-product. A model, that combine the chemical net reaction and the stoichiometric rules, is found to agree with measured deposition rates for given material compositions. Effects of annealing in a nitrogen atmosphere has been investigated for the 400 °C–1100 °C temperature range. It is observed that PECVD oxy-nitrides release nitrogen and hydrogen in the form of NH for annealing temperatures in the 500 °C–700 °C range. The relaxation process during annealing is found to be governed by a viscoelastic relaxation process similar to the relaxation process observed for thermally grown SiO2. Upon nitrogen release, the PECVD material is in a state of internal tension. The viscoelastic relaxation process for temperatures above 700 °C is dominated by the relaxation of this internal tension. A linear relation between the refractive index and material density is determined for silicon oxy-nitride with a nitrogen concentration below 30 at. %. ©1995 American Institute of Physics.

General information
Publication status: Published
Organisations: Department of Micro- and Nanotechnology
Contributors: Mattsson, K. E.
Pages: 6616-6623
Publication date: 1995
Peer-reviewed: Yes

Publication information
Journal: Journal of Applied Physics
Volume: 77
Issue number: 12
ISSN (Print): 0021-8979
Original language: English
Electronic versions:
   mattsson.pdf
DOIs:
   10.1063/1.359072
URLs:
   http://link.aip.org/link/?JAPIAU/77/6616/1

Bibliographical note
Copyright (1995) American Institute of Physics. This article may be downloaded for personal use only. Any other use requires prior permission of the author and the American Institute of Physics.
Source: orbit
Source-ID: 247673
Research output: Contribution to journal › Journal article – Annual report year: 1995 › Research › peer-review