Thin Solid Films, *165* (1988) 181–191
PREPARATION AND CHARACTERIZATION

MECHANICAL STRESSES IN LOW PRESSURE CHEMICALLY VAPOUR DEPOSITED SILICON FILMS

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(Received December 22, 1987; accepted May 4, 1988)

Stresses *vs.* deposition temperature and annealing time have been studied in silicon films 0.15 and 0.30 μm thick. The films were deposited onto oxidized silicon wafers by low pressure chemical vapour deposition from a gas mixture containing 5% SiH_4 and 95% Ar in a horizontal-type reactor at temperatures of 793–853 K. The films were annealed during 0.25–1.0 h flowing argon at 1223 K. Stresses have been found to increase from about 300 to about 500 MPa as the deposition temperature increases from 833 to 853 K. This is due to oxidation of film crystallites during deposition and a change in the condensation mechanism with temperature. The validity of a model allowing for crystallization of the amorphous phase during deposition has been confirmed by X-ray diffraction, reflection high energy electron diffraction and scanning electron microscopy.

It is shown that a decrease in compressive stresses in the films containing a considerable fraction of amorphous phase is caused by crystallization and dynamic recrystallization of the films owing to annealing. A general equation has been derived which describes changes in the film elastic energy during crystallization taking into account plastic deformation. By using the deformation mechanism map it is shown that the stress reduction during annealing of polycrystalline films is caused by low temperature dislocation (power law) creep.

РЕПОЗИТОРИЙ БГПУ

1. INTRODUCTION

Thin amorphous and polycrystalline silicon films are widely used in microelectronics for the production of large- and very-large-scale integrated circuit (IC). Understanding of the nature and relaxation mechanisms of stresses is necessary in using thin silicon films in multilayered structures and especially in three-dimensional ICs[2].

The purpose of this paper is to study stress generation and relaxation mechanisms in thin silicon films prepared by low pressure chemical vapour deposition (LPCVD) from silane at temperatures of 793–853 K and annealed under a constant temperature.

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