[Display Technology]

Formation kinetics of Si clusters in silane HF discharges and their growth control

Yukio Watanabe
Graduate School of Information Science and Electrical Engineering,
Kyushu University, Fukuoka 812-8581, Japan

Producing high quality hydrogenated amorphous silicon (a-Si:H) films at a high deposition rate is vital to promote extensive use of solar cells as power sources. The a-Si:H films are usually made using capacitively-coupled high-frequency (HF) silane discharges, because this type of discharge can produce radical species SiH3s, contributing to formation of good quality film, at a large generation rate compared to another types. However, efficiency of a-Si:H solar cells is not so high and further decreases with time by light-soaking. Furthermore, to put the cells to practical use, the deposition rate of a-Si:H films must be about ten times as high as the present one. Such high rate deposition of films has been known to result in severe powder formation leading to deterioration of their quality.

Recently, the light-induced defect was found to be closely correlated with the existence of higher-order silanes, SinHxs(n<4)[1]. This result implies that the defect may be closely related to the existence of clusters, being fine particles below ~nm in size, because they coexist with SinHx s (n<4). Thus, I and my co-workers have developed two in-situ methods for observing the growth of clusters in silane (SiH4) HF discharges: photon counting laser-light-scattering and double-pulse-discharge methods[2,3]. These methods have made it possible to study the growth processes of clusters and effects of some parameters related to the discharges on the cluster growth[3,4].

In this talk, I will review recent results obtained in my laboratory, regarding the cluster growth in SiH4 HF discharges, which are composed of the following three items: (1) A cluster growth model which is able to explain reasonably whole results reported until now: (2) Effects of temperature-gradient and flow of gases in the reactor, hydrogen dilution,

periodical discharge modulation and excitation frequency on the growth of clusters: (3) Quality evaluation of films deposited under suppressing their growth by applying some of the effects described in the item (2)[5,6].

[References]

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