GROWTH OF COMPOUND SEMICONDUCTOR FILMS FROM AQUEOUS SOLUTIONS

by

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"Ignorant and inactive minds confound familiarity with knowledge and conceive themselves informed of the whole nature of things when they are shown their form or told their use; but the speculatist, who is not content with superficial views, harasses himself with fruitful curiosity and still as he enquires more, perceives only that he knows less."

Dedicated to-

ALL THOSE WHO LOVE SCIENCE AND FREEDOM

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ABSTRACT

The solution growth technique of film deposition for compound semiconductors using controlled precipitation from aqueous solutions has been studied in detail and the kinetics and mechanism of growth established. A model for nucleation and growth has been proposed. Briefly according to this, depending on the deposition conditions film growth can take place either (i) by ion-by-ion precipitation of the material on the substrate or (ii) by adsorption of colloidal particles of the material from the solution. The former mechanism gives rise to thin, adherent,compact and specularly reflecting (A-quality) films and the latter to thick, relatively loosely adherent, diffusely reflecting and powdery (B-quality) films. A comparative study of this technique with various other existing techniques has also been done. It has been observed for the first time that even for the same set of reacting chemicals, the crystallographic structure of the film may depend on the deposition conditions, for example, temperature, mechanical agitation of the solution and the presence of a solid phase in the solution (heterogeneous precipitation). Both polymorphic phases wurtzite and sphalerite are obtained for the case of CdS films.

The structural, optical, electrical and photoconducting properties of solution grown CdS films have been studied in detail and compared with those of the films deposited by

other methods. High gain photoconductors were fabricated using these CdS films. It has also been demonstrated that these CdS films are suitable for other applications as photovoltaic and photoelectrochemical conversion of solar energy using CdS-Cu_2S and CdS/Na_2S-S-NaOH/C heterojunctions. It has also been found that solution grown CdS and ZnS films are suitable for fabrication of luminescent devices.

The versatility of the technique has been demonstrated by extending it to semiconductor alloy systems and doped systems. Chemistry of the technique for alloy formation has been studied in detail and solid solutions of CdS-HgS and CdS-ZnS formed. Using this technique CdS films were doped with Cu and effect of Cu concentration on photoconductivity of CdS films was studied. Suggestions for future work in this area are given in the end.

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CONTENTS