

Investigation of Optical and Structural Properties of CdS Thin Films

A. Ates, M. A. Yildirim, M. Kundakçi, and M. Yildirim

Department of Physics, Science and art faculty, Atatürk University, Erzurum, Torkey
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CdS thin films were prepared by the successive ionic layer adsorption and reaction (SILAR) method. The optical properties of these films have been investigated as a function of temperature. The band gap energy change, steepness parameter, and Urbach energy parameters were also investigated as a function of temperature. The band gap energies were calculated at 10 K and 320 K, as 2.427 and 2.377 eV for CdS thin film, respectively. Film morphology was characterized by scanning electron microscopy and XRD measurements.

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I. INTRODUCTION

The films formed by wide gap II-VI semiconductors are of considerable interest, as their emissions cover the technologically attractive blue and green spectral region. In particular, thin CdS films deserve attention because their expected gap emission lies very close to the highest sensitivity of the human eye. Thus, one might assume that thin CdS thin films are an appealing host for photonic devices [1]. Cadmium sulphide (CdS) is an important and useful material for optoelectronic applications. Undoped CdS thin film is always grown as n-type [2]. The CdS quantum dot embedded in a glass matrix is one of the well-known quantum dot systems and its electronic and luminescent properties have been studied extensively [3, 4]. II-VI semiconductors are used as optical windows for solar cells [5]. Recently there has been extensive work on the deposition of thin film materials such as CdS. This material was prepared by several methods including evaporation [5], sputtering [6], chemical bath deposition (CBD) [7], spray [8], molecular beam epitaxy (MBE) [9], and metal organic chemical vapour deposition (MOCVD) [10]. The successive ionic layer adsorption and reaction (SILAR) technique was introduced by Nicolau in the mid-1980's [11]. The method has been employed to grow selected II-VI compounds, especially CdS and ZnS. In the SILAR method, a substrate is immersed separately into precursor solutions and washed in between by water to get rid of the loosely bound species. Thus the content of one SILAR-cycle is adsorption of cationic precursors, rinsing with water, adsorption of anion precursors, followed by reaction, and again rinsing. The growth rates of the thin films in the SILAR technique have varied between a quarter and a half of a mono layer depending on the experimental conditions [11–14].

This growth rate shows that aqua ligands at least partially stay intact during adsorption, thereby lowering the density of cations and anions in one layer. However the growth of a thin film can be controlled at an accuracy of one SILAR-cycle. The successive ionic layer