CHAPTER I

CHAPTER ONE

Introduction

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1.1 Solar Energy Conversion:

It has been recognised, recently, that energy supplies from conventional sources are taking a strategic significance because of their rapid depletion. In this situation the use of solar energy, cut of the various possible new energy sources, is important because of its maximum and ever lasting abundance and relatively easier means of trapping. Solar energy conversion can be carried out in various modes: (1) Photothermal (2) Photovoltaic (3) Photochemical (4) Photobiochemical and (5) Photoelectrochemical. The photovoltaic and photoelectrochemical means of harnessing solar energy have attracted maximum attention because of their simplicity and proven potential for conversion.

1.2 Survey of the Literature on Bi_2O_3 and Bi_2S_3 :

Bi_2O_3 orrange yellow in colour, dimorphus in nature has transition temperature 704°C. At this temperature Bi_2O_3 melts and after cooling it shows crystalline form. Bi_2O_3, when dipped in to a Na_2S solution, becomes black, forming Bi_2S_3 [1]. Metikos-Hukovic[2] have studied Bi_2O_3 films. Anodic oxide films on bismuth are amphoteric semiconductors with n-type and p-type behaviour and an optical gap 2.8 eV, at room temperature. The semiconducting properties were analysed in situ during the study of electrochemical and photoelectrochemical reactions at the phase boundary oxide-electrolyte.

The photopotential, photoconductivity and capacity measurements together with the electrochemical measurements have been shown to be valuable tools in the connection of bulk properties with surface properties. Thermodynamic stability is discussed and data are given which refer to mechanism and kinetics of cathodic decomposition and photodecomposition of the Bi_2O_3 layer. Dolocan, Iova[3] studied optical properties of Bi_2O_3 thin films. The optical absorption in flash evaporated Bi_2O_3 thin films is studied in the photon energy range 0.6 to 6.2 eV. The tetragonal Bi_2O_3 is found to be an indirect gap insulator with an energy gap _ 2.6 eV at room temperature. Howders, J.H.W. de[4] investigated thermoelectric power in Bi_2O_3. Miyayama et al[5] carried out study of polymorphic transformation and electrical resistivity of Bi_2O_3.

The photoelectrochemical behaviour of chemically deposited Bi_2S_3 thin films in aqueous solution is studied by Bhattacharya and Pramanik[6]. Their work concludes that deposition of bismuth chalcogenides depends on the pH of the solution. The electrical resistance, mobility and carrier concentration of bismuth chalcogenides have been measured. Optical absorption spectra reveals the bandgap which is 1.47 eV. Activation energy of electrical conduction of Bi_2S_3 obtained is 0.9 eV. Chemically deposited thin films of Bi_2O_3 by Bhattacharya and Pramanik are amorphous in nature[7]. Pawar et al[8] have studied Bi_2S_3 films of about 0.3 μ thickness, prepared by solution-gas

interface technique. The bandgap energy of Bi_2S_3 film estimated from both electrical and optical measurements is found in fair agreement with the results reported by others.

1.3 Statement of the Problem:

Recently with the increased cost of traditional energy sources such as coal, neutral gas, petroleum and nuclear fission; the photovoltaic conversion[9] of solar energy to electric power has attracted increasing interest, primarily for low cost terrstrial applications. The photovoltaic conversion is direct energy conversion process and ideally, should be efficient and clean. Electrochemical photovoltaic (ECPV) cell has received wide attention for solar energy conversion. In this investigation an attempt has been made to prepare suitable photoanode semiconductor to use in ECPV cell. In order to achieve the goal, systematic study is planned (1) out of several methods for deposition of films, the spray pyrolysis technique has been used to prepare Bi_2O_3 films (2) Bi_2S_3 films, which are sensitive to light are obtained from Bi_2O_3 films, by dipping Bi_2O_3 films in to the sodium sulphide (Na_2S) solution, (3) optical absorption of both Bi_2O_3 and Bi_2S_3 films is carried out, (4) Bi_2S_3 film, deposited on conducting glass substrate, is used as a photoelectrode. The ECPV cell is formed with Bi_2S_3 film as photoelectrode, 0.1 M NaOH, Na_2S_3 as electrolyte and carbon as a counter electrode. The ECPV cell Bi_2S_3/ 0.1 M NaOH,Na_2S, S/C is formed and is used to study the electrical properties.

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