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Fabrication and Characterization of Manganese Based Thin Films in Optoelectronic Applications

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***Abstract* - The objective of the present work is to pursue and characterize the physical properties of inorganic transparent conducting oxide thin layer films made by spin-coating technique/spray pyrolysis technique and compare these properties with other sensitizing agents. It isexpected that this method will lead to the development of a new platform for the contribution of inorganic TCOs' physical properties. I also hope that this technique will be helpful to enhance the efficiency and potency of solar cells and other optoelectronic devices.**
***Keywords:* Pervoskite Materials, AM_nO or BaM_nO, Optoelectronic Devices, Inorganic Residuals**

I. INTRODUCTION

A lot of electrical and optical applications of transparent conducting oxide thin layer films have been studied thoroughly. Some of these uses include liquid crystal displays (LCD), different solar cells, and inorganic light emitting diodes (LED) etc. [1-4].

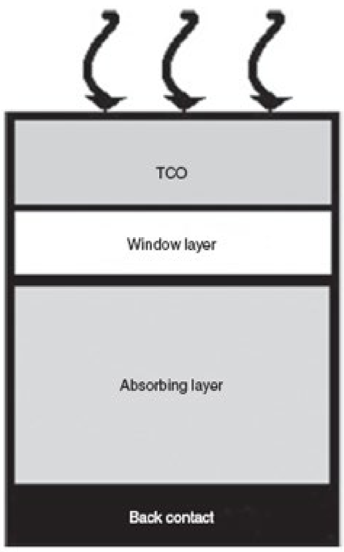

Fig. 1 A solar cell's typical structure made of thin layer films

Thin-film materials fabricated by TCO thin layers used in solar cells have high thermal stability, low specific resistance, and high transmittance. [5, 6] In this paper, we present a new class of materials that can be used to improve the performance of solar cells by providing a light harvester. These materials are able to bridge the gap between sensitized solar cells and conventional thin-films.

II. LITERATURE REVIEW

Indium-tin-oxide is commonly used as a type of perovskite material due to its exceptional optical and electrical properties. [7] Due to low stability, great toxicity, very expensive and being a rare material, ITO encourages developing substitutes. Due to the excellent properties and low cost, manganese oxide (MnO_2) is considered a promising material to replace ITO. [8]

To increase the electrical conductivity and optic transmittance of MnO_2 layers, group III elements like Boron (B), Aluminum (Al), Indium (In), Gallium (Ga), Barium (Ba) etc., are generally apprised to MnO_2. Doping and un-doping of MnO_2 layer films will be made by various deposition ways. Examples are spray pyrolysis, spin coating method, thermal evaporation, DC and RF magnetron sputtering, electron beam evaporation (EBV) etc. [9-17]

In the present research, Al doped MnO_2 (AM_nO) and Ba doped MnO_2 (BaM_nO) thin layers will be prepared by spin-coating method/spray pyrolysis method. These special techniques provide some distinct advantages. For examples, easy apparatuses, less fabrication expense, rich homogeneity and broad deposition area. The effects of Al and Ba dopants are compared by the electrical, optical and structural features of AM_nO or BaM_nO thin layer films as the operation of concentration of doping.

III. METHODOLOGY

We pick the spin-coating technique/spray pyrolysis technique for thin layers readiness. $Ba(NO_3)_2$/BaCl, $Al_2Cl_3.6H_2O$, and MnO_2 solutions are employed as inaugurating ingredients. Al and Ba dopant concentrations impact on the properties of Al and Ba doped thin layer films, their concentrations are changed at 0, 0.5, 1.0, 1.5, and 2.0 mol percent with respect to Manganese. The results are waved at 60 °C for 2 hours togive distinct and intrinsic solutions.

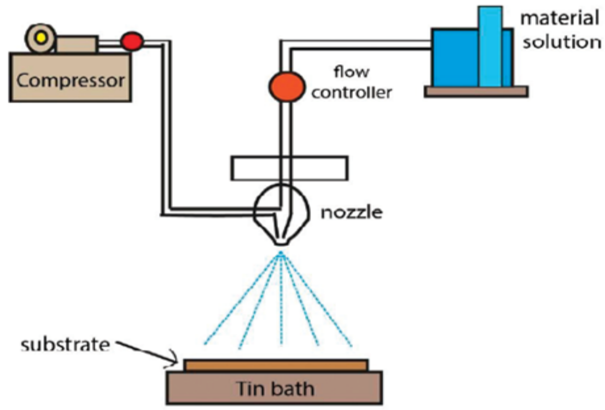

Fig. 2 Spray pyrolysis technique

The air in the nozzle is met by the solution through the tubes to produce the spray that is arrived on the substrate which is warmed to deposit the ingredient. The concentration of solution, pressure, substrate temperatures are the variables here.After that, marketable glass is cleansed in acetone, methanol and distilled water ultrasonically for five (5) minutes respectively. Then, MnO_2 films are deposited on marketable glass by spin-coating system/spray pyrolysis system. [18-20]

The spin coating method is operated at room temperature with a rate of 150 rpm/s. After deposition, the thin layer films are heated at temperature 300℃ for duration of 10 minutes on a hot plate for evaporating the solvent and to eradicate the in-organic growth.

The proceeding methods from coating to drying up are succeeded by 6 times. Then the layer films are kept in a furnace and thereafter heated in air at a temperature 650℃ for half and one hour.

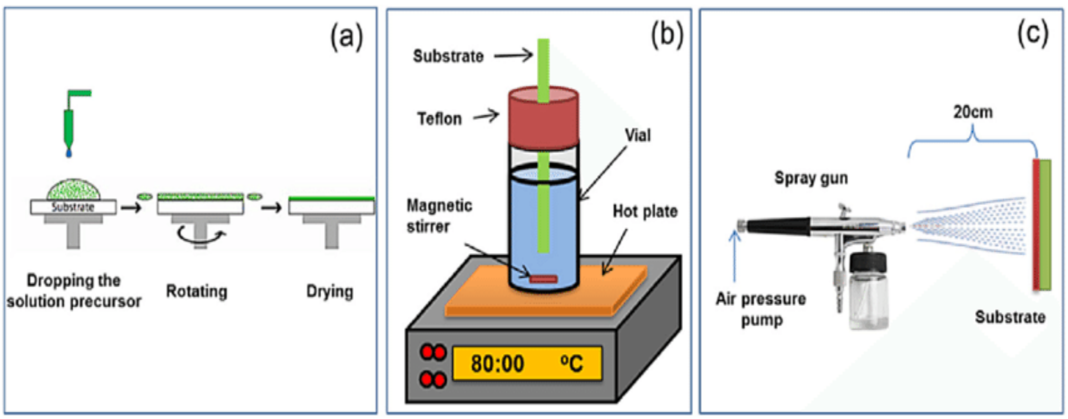

Fig. 3(a) Spin-coating method to get the manganese layer, (b) the improvement method next the reference layer prepared, (c) hand held spray gun spray-coating system

An X-ray diffractometer (in sort XRD) analyses the crystalline structures of the specimens. A Scanning Electron Microscope (in sort SEM) gives the surface microstructure of the samples. Four point probe system measures the electrical resistances. UV-VIS spectrometry method conveys and measures their optical transmittance. Photoluminescence (PL) spectrometer records the PL spectra while being excited with a He-Cd laser of 325 nm at the room temperature.

IV. CONCLUSION

The refocus of transparent conducting oxide ingredients in the thin layer Si solar cell technology seems to be extremely challenging endeavor. The outcomes of the present work ensure that both the AM_nO and BaM_nO thin layer film materials are compatible for the usage in thin film Si solar cells. The both substances have almost analogous electrical and optical properties. When the back contact of Ag is embodied with an AM_nO or BaM_nO thin layer film, then it shows the following results: a boosted reflectivity, a bettered adhesion comparing to a bare Ag substrate. Therefore, the modules of thin layer films with a huge, long period of durability are being optimized. However, any enhancement of transparent conducting oxide material use can have a huge profitable impact, if thin layer films in silicon solar cells are improved to contribute remarkably to the solar energy producing sources for the world. In this study, the microstructures of AM_nO or BaM_nO thin films are homogeneous, and the thickness of the final film is about 150 nm.

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