Chemical Science Review and Letters ISSN 2278-6783

Research Article

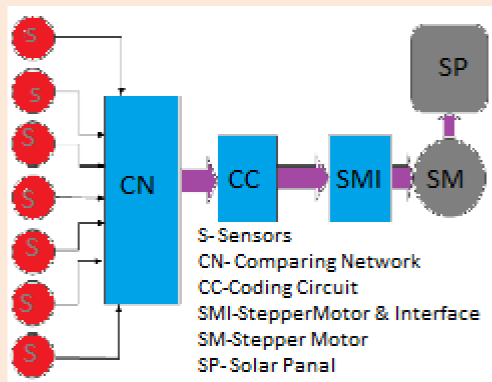
Low cost intelligent Solar panel with ZnO sensors

Jibish Mathew[1] and Deepu Thomas[2]

[1]Prajyoti Niketan College, Pudukad,Thrissur, Kerala, India 680 301
[2]Research and Development Centre, Bharathiar University, Coimbatore, India 641046

Abstract
Zinc oxide (ZnO) films were successfully synthesised by microwave assisted successive ionic layer adsorption and reaction (mSILAR) technique. The effect of sunlight irradiation on the electrical property of sample was examined. The resistance at different time intervals by varying angles of the sample was noted and also compared the meaurement with unirradiated sample. The resistance found to be decreased from MΩ to kΩ range with the raise in the light intensity. Hence ZnO thin film can be used as a sensor for intelligent solar panels, in which the panels always face the Sun, so that the efficiency of the panels is improved by avoiding reflection loss.

Keywords: Zno, mSILAR, Irradiation, Solar panel, Sensor



***Correspondence**
Author: Jibish Mathew
Email: jibishm@gmail.com

Introduction

Solar energy is the most easily available source of renewable energy. Solar energy is converted to electrical energy & used as a power station. Solar power plants use Solar Panels to capture this highly resourceful energy. Solar Panels contain solar cells which has an ability called Photovoltaic Effect. With this effect these solar cells convert the light energy into voltage energy. In solar panel, the solar cells are covered with glass to protect them from the environment and glass is an integral part of solar cells. However any glass material has a property to reflect light if Angle of incidence is other than 90 degree. Reflection causes reflection losses, which in-directly affects the efficiency of the solar panel. In solar cell technology, ZnO can be employed as window layer materials due to its property to transmit UV/VIS radiation through them and to conduct electric currents with low resistive losses [1-9]. ZnO is one of the most prominent candidates for photovoltaic device as an n-type buffer material in CdTe based solar cell due to its wide band gap of 3.3 eV [1-3]. ZnO thin films have attracted several researchers for improving the efficiency of heterojunction solar cells. In the case of ZnO, the transparency to visible light and highly tunable electrical conductivity provide a range of technologies that are important to the modern world [4-5].

Many researchers have reported the different properties of ZnO on light irradiation, especially on photoconductive effects, where the electrical conductivity of ZnO changes upon irradiation [5-6]. These properties can be used in a variety of sensing applications. Most of the reported works are based on so-called "persistent" photoconductivity, which means that its effects decay only over a time scale of hours to days when a sample that has been irradiated [5]. Even though, there are reports on different properties of ZnO on light irradiation, a study on the variation of resistance with intermittent time intervals is not yet carried out extensively. In the present investigations, variation of resistance with intermittent time intervals and different angles of ZnO thin films are studied.

Experimental

ZnO thin films were prepared by microwave assisted Successive Ionic Layer Adsorption Reaction (mSILAR) method, in which, the ZnO thin film was coated on a glass substrate (26 × 76 mm) by alternately dipping it in a sodium zincate bath at room temperature and then in hot water maintained at 90-95 ^{o}C. The well-cleaned substrates were immersed in the chemical bath for 10 second followed by immersion in hot water for an equal duration and the process was repeated for 100 times. Then the sample was microwave irradiated and annealed in a microcontrolled annealing chamber at 400^{o}C for half an hour. The electrical resistance of ZnO thin film was measured by Keithley 2100 Digital Multimeter.

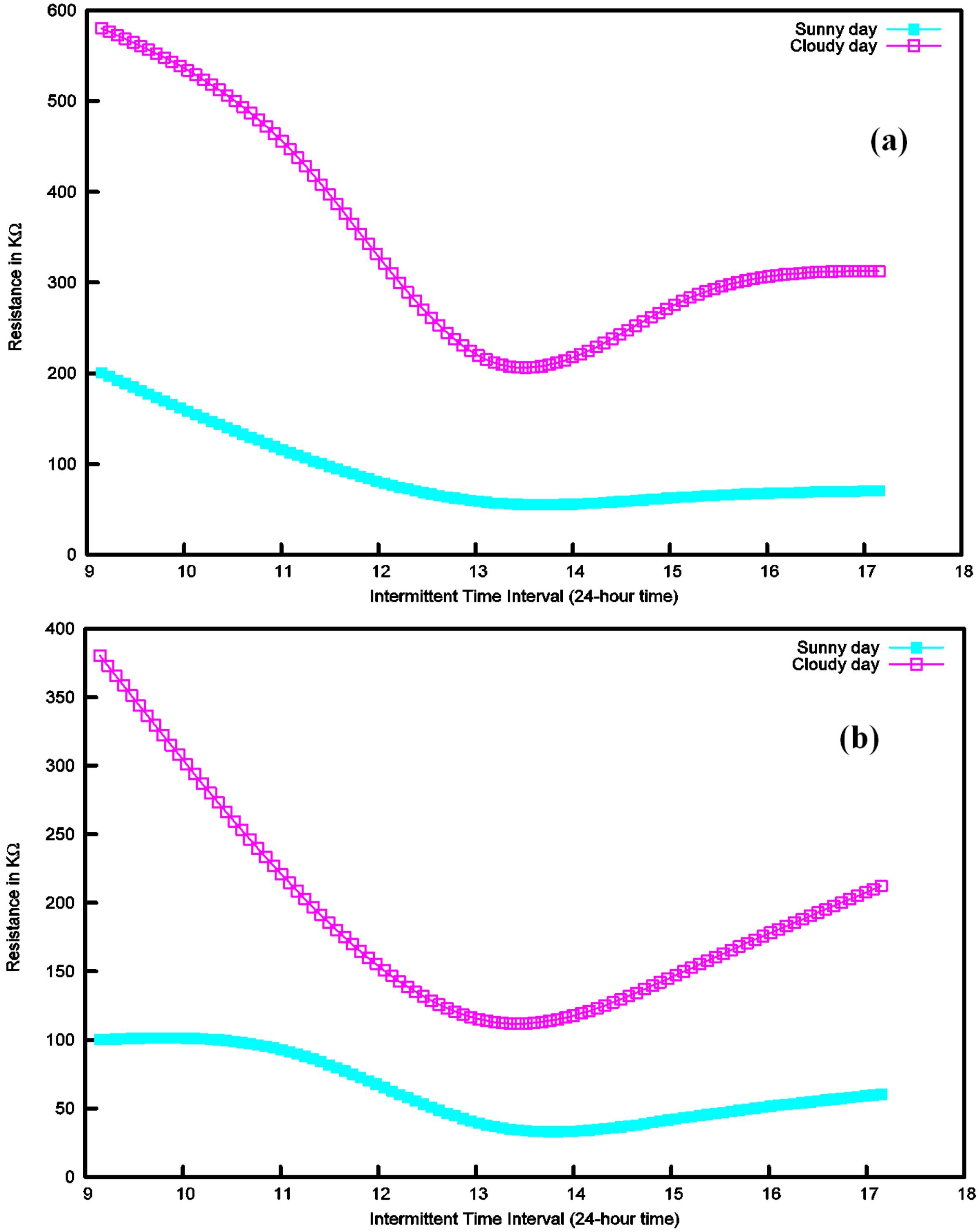


Figure 1 (a) The variation resistance at intermittent time interval at 45^{o}. (b) The variation resistance at intermittent time interval at 90^{o}

Results and discussion

Resistance Measurements

The thin film resistivity was greatly influenced by the interaction of the conduction electrons with the surface. In other words, it is a measure of the material's inherent surface resistance to current flow. The resistance of sample is measured at room temperature and observed value is 2 MΩ.

Resistance Measurements of Sun light Irradiated sample

The resistance measurements are performed again by irradiating the sample by sun light at different time interval and also varying the angle of the sample. The variation of resistance with intermittent time intervals at 45 ^{o} and 90 ^{o} is in the **Figure 1** (a) and (b) respectively. From the figure it is clear that the variation of resistance is similar in the case of both sunny and cloudy days. But in the case of sunny day, the variation is more compared to the other. It was also noticed from the figure that when light intensity was maximum, the observed value of resistance was very low, and the resistance measurement was found to be affected by the variation of the angle of the sample. Both the angles showed similar behaviour but, the noted value was low in 90 ^{o} (Figure 1 (b)).

Fabrication of sensors with ZnO

In this section describes how ZnO films works as sensors. Here S1, S2, etc are sensors **Figures 2** and **3**. Each sensor is separated by an angle of 30 degree. The comparator network is used to compare the out put of the sensors. Since the semi circled ring is aligned in the East- West direction, out put from the sensors are always different. The outputs depend on the position of the Sun. The coding unit is used to decode the information from the comparator network and the stepper motor interface is used to interface the coded data and stepper motor. The stepper motor is mechanically connected to solar panel. Ultimatelly the solar panel face the sun in the entire day. So efficiency is very high.

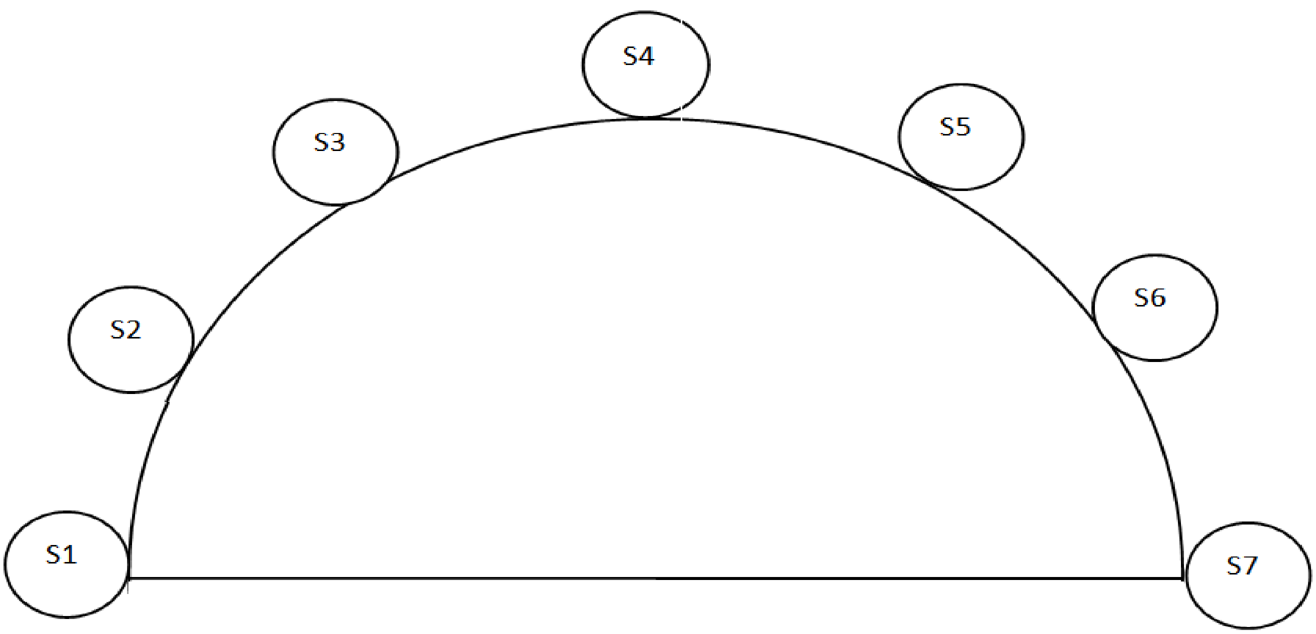


Figure 2 shows the alignment of ZnO sensors on a semi circled ring.

Conclusion

The following conclusions can be drawn from the studies. ZnO films were prepared by mSILAR method. The effect of irradiation of visible light on the electrical property at intermittent time intervals and by varying angles of the sample was studied and a model of a sensor that can be employed for solar pannels also designed here. Thus synthesised film can be used as a sensor for intelligent solar panels.

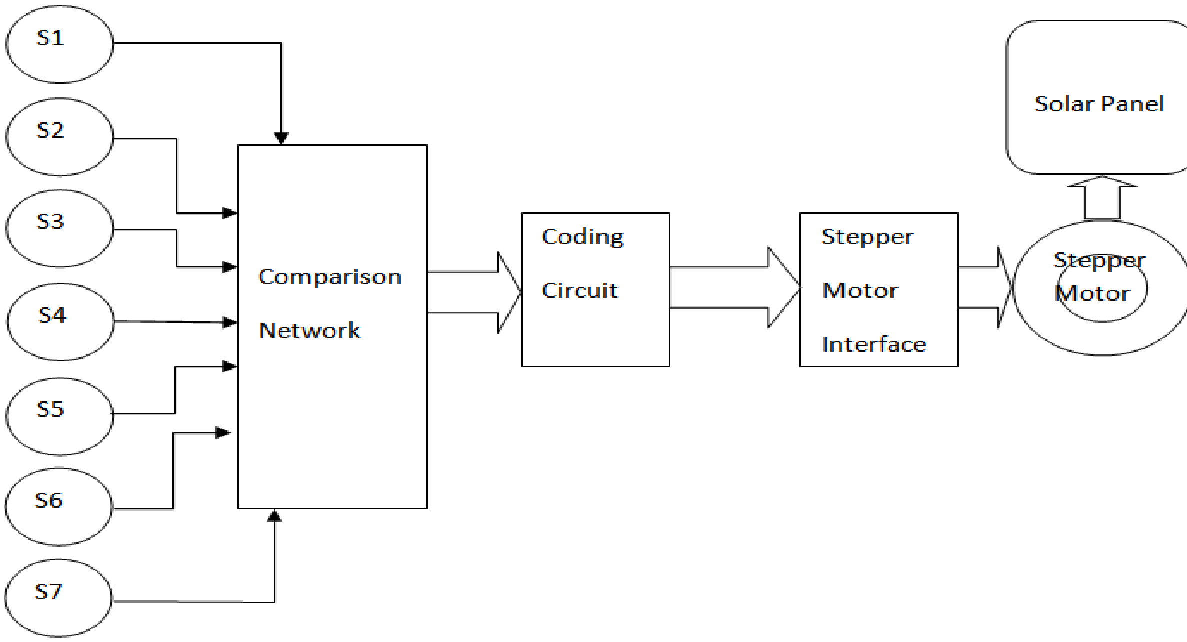


Figure 3 shows the basic block diagram of the system.

References

[1] A. Mhamdi, A. Boukhachem, M. Madani, H. Lachheb, K. Boubaker, A. Amlouk, M. Amlouk, Optik 124, 2013, 3764–3770.
[2] F. Benharrats, K. Zitouni, A. Kadri, B. Gil, Superlattices Microstruct. 47, 2010, 592–596.
[3] P. Lv, L. Lin, W. Zheng, M. Zheng, F. Lai, Optik 124, 2013, 2654–2657.
[4] A.J. Hashim, M.S. Jaafar, A.J. Ghazai, N.M. Ahmed, Optik 124, 2013. 491–492.
[5] J.F. Chang, H.H. Kuo, I.C. Leu, M.H. Hon, Sens. Actuators B Chem. 84, 2002. 258.
[6] P. Mitra, A.P. Chatterjee, H.S. Maiti, Mater. Lett. 35, 1998, 33.
[7] H. Nanto, T. Minami, S. Takata, J. Appl. Phys. 60, 1986. 482.
[8] W. Gopel, J. Vac. Sci. Technol. 16, 1979, 1229.
[9] V. Avrutin, U. Ozgur, N. Izyumskaya, S. Chevtchenki, J. Leach, J.C. Moore, A.A. Baski, C. Litton, H.O. Everitt, K.T. Tsen, M. Abouzaid, P. Ruterana, H. Morkoc, Proc. SPIE 6474, 2007. 64741M.
[10] D. Thomas, S.C. Vattappalam, S.Mathew, S. Augustine, Journal of Optoelectronics and Biomedical Materials 6(3), 2014, 75–83.

Publication History
Received 10th Sep 2015
Revised 14th Sep 2015
Accepted 19th Sep 2015
Online 30th Oct 2015