Development of Thin Film Sensor Using Dip Coating Machine Using IoT Technology

[1]Sanniti Rama Krishna, [2]Satyavarapu Archana, [3]Jadda Aswini, [4]Thota Veerendra Babu, [5]Seelam S K M L Sandhya
[1]Assistant Professor, [2]Student, [3]Student, [4]Student, [5]Student,
[1]Electronics and Communication Department,
[1]Godavari Institute of Engineering and Technology, Rajahmundry, India

Abstract : In the last two decades the various equipment's are being changed to deposit thin film coatings. Previously, a typical coating machine which was completely manual or semiautomatic also required a highly skilled operator was used to produce consistent results. The increasing sophistication of the user translates to ever more demanding specifications for system performance; it is not unusual for customers to buy process expertise along with the machine. In this project an attempt has been made to examine the components and subsystems which are available for today's thin film coating systems, highly tuned thin films, in terms of thickness, crystalline, porosity and optical properties, can be fabricated on different substrates using the sol-gel method, chemical vapor deposition (CVD) and physical vapor deposition (PVD). In this paper, an internet of things (IOT) based technology was used to develop the thin film which were coated with the help of dip coating machine. The hardware components DHT11 (Temperature Sensor), ultrasonic sensor and L293Dare linked to Node MCU analog and digital IO pins**.**

IndexTerms **- Dip coating, Thin film, Internet of Things (IoT), NODEMCU**

I. INTRODUCTION

Due to the evolution of material science and engineering concept in the novel materials with extraordinary combination of chemical, physical and mechanical properties a drastic change happens in the modern society. The increasing modern technology requires thin films for different applications. Thin film technology is the basic of astounding development in solid state electronics. The usefulness of the optical properties of metal films, and scientific curiosity about the behaviour of two-dimensional solids have been responsible for the immense interest in the study science and technology of the thin films. Thin film studies have directly or indirectly advanced many new areas of research in solid state physics and chemistry which are based on phenomena uniquely characteristic of the thickness, geometry and structure of the film.

Thin films are especially appropriate for applications in microelectronics and integrated optics. However, the physical properties of the films like electrical resistivity do not substantially differ from the properties of the bulk material. For a thin film the limit of thickness is considered between tenths of nanometre and several micro-meters. Thin film materials are the key elements of continued technological advances made in the fields of optoelectronic, photonic, and magnetic devices. The processing of materials into thin films allows easy integration into various types of devices. The dip coating machines are the most important instrument which are used in fabrication and characterisation operation. The main aim of this paper, is to develop an IOT based thin film sensor using DIP coating machine.

II. METHODOLOGY – DEVELOPMENT OF THIN FILM TECHNOLOGY

In the dip coating method, the substrate is slowly dipped into and withdrawn from the tank containing the solution, with a uniform velocity, in order to obtain a uniform coating. A microcontroller-based system along with user friendly software takes care of accurate control throughout the process. Speed, traverse and idling duration can be programmed through the controller. The system is complete with mechanics, substrate holder, electronics and software. Dip coating is done by immersing a substrate into a tank containing the coating material, removing from the tank, and allowing it to drain. The coated piece can then be dried by force-drying or baking. The block diagram of the complete process is presented in Figure 1. Film formation in dipping is dependent on the viscosity of the fluid. The process is messy and can be highly hazardous. The viscosity of the fluid in a dip tank must remain practically constant if the deposited film quality is to remain high. Dip coating is well suited for high production coating of relatively simple shapes. Transfer efficiency is very high, all contact areas are coated, equipment requirements are low, and the process can be automated.

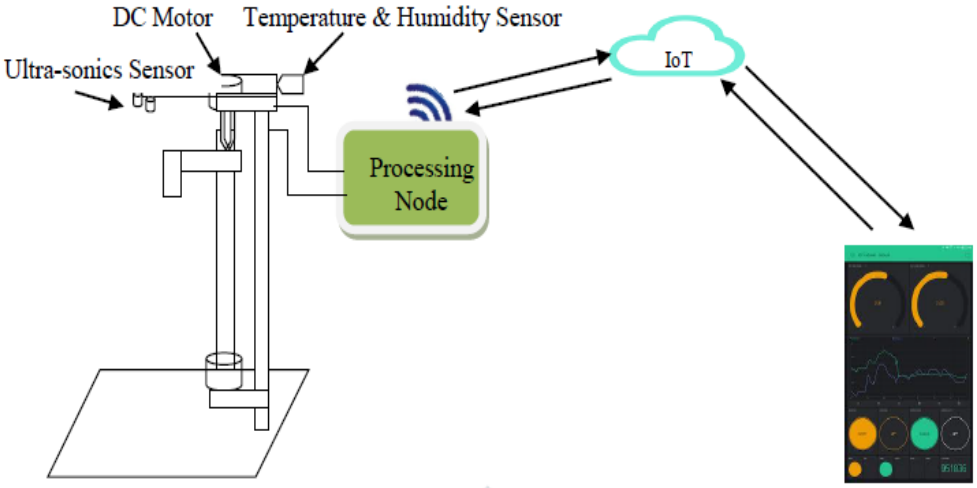

Figure 1: Framework of IoT Controlled Dip Coating System

In this dip coating unit, the substrate is dipped in the solution and then withdrawn into a heating chamber. Temperature of the chamber can be controlled and fixed up to 75°C from ambient. The system has a user-friendly system. It can as well be controlled through a controller. Dip duration, dip speed, baking duration, withdraw at speed etc. are programmable features. To process the program feature and cloud structure the schematic circuit diagram was used, which is shown in Figure 2.

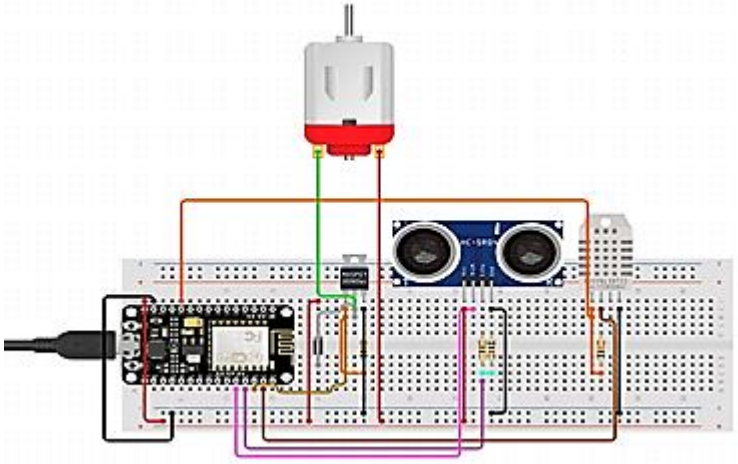

Figure 2. Circuit Diagram

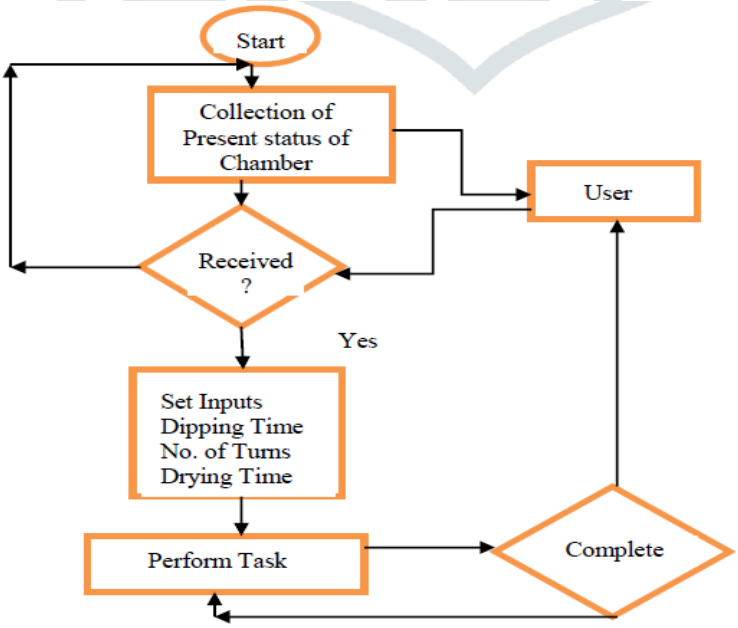

Figure 3: Flow Chart of Methodology

The Microcontroller gets the data from the sensors at stipulated intervals. After dumping the code into microcontroller, if the power supply provided on it, first it connects to Wi-Fi by using the credentials which are given in program as username and password of Wi-Fi. Afterward, it connects to Blynk cloud using Authentication token given in program.
Blynk is a mobile application which is an open source app to operate things through Wi-Fi. To check whether the microcontroller connect to Blynk or not we open the Blynk app. Then it shows it is online if it connects to cloud otherwise it shows offline. The sent authentication key is to be used in program with local wifi user name and password to make connectivity between Blynk App and wifi enabled card.

III. RESULTS AND DISCUSSION

Dip coating unit has been designed and developed in this paper which is used to keep operator involvement as minimum as possible so that variables like speed, duration, etc. are maintained accurately by microcontroller. Movements are achieved by a precision motor controlled linear stage. In this initially work, the required dip was entered into the solution s per the dip require for the structure by dip coating machine. The process was done by using keypad matrix and it starts by giving instruction through arduino to the motor driver. Based on temperature and humidity the process goes on, when substrate is raised up from solution the bulb glow to make required temperature for drying of solution on substrate. This process takes until required thickness is obtained by dipping and raising from solution.

IV. CONCLUSIONS

The designed system can be used for development of various low-cost thin film sensors for various applications like biomedical sensors. Further, the system can be easily modified based on the requirements of the materials that is being used for development of thin film sensors. In this paper, the formation of thin film using dip coating machine have described successfully by applying the internet of things technology on it. Thin layers were formed depending upon Viscosity of solution, time taken for raising up and down into the solution. The developed IOT sensor showed the result of slower speed of raising-up associated with the thin film and in the similar manner the higher speed of raising-up associated with thicker film. This developed thickness of layer was observed using microscope.

V. REFERENCES

[1]. D.C. Hyung, J.K. Hong, B.M. Moo, Y.J. Deuk, Applied Surface Science 255 (2009) 3480–3484.
[2]. D. Djouadi, A. Chelouche, A. Aksas, M. Sebais, Physics Procedia 2 (2009) 701-705.
[3]. L. Jin, F. Huiqing, C. Xiaopeng, C. Zhiyi, Colloids and Surfaces A: Physicochem. Eng. Aspects 349 (2009) 202–206.
[4]. K. Takahashi, Wide Bandgap Semiconductors Chairman of the 162 Committee, JSPS,Tokyo 2005.
[5]. R. Gupta, N.K. Chaudhury. "Entrapment of biomolecules in sol-gel matrix for applications in biosensors: problems and future prospects". Biosens Bioelectron 22 (2007) 2387–2399.
[6]. B.E. Yoldas. "Monolithic glass formation by chemical polymerization". Journal of Materials Science 14 (1979) 1843.
[7]. K.P. Bhuvana, J. Elanchezhiyan, N. Gopalakrishnan, T. Balasubramanian, Materials Science in Semiconductor Processing 14 (2011) 84–88.
[8]. A.Hafdallah, F. Yanineb, M.S. Aida∗, N. Attaf, J. Alloys and Compo 509 (2011) 7267–7270.
[9]. T. Wang, Y. Liu, Q. Fang, Y.Xu, G. L, Z. Sun, M. Wu, J. Li, H. He, Journal of Alloys and Compounds 509 (2011) 9116– 9122.