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# Design and Development of Spin Coating Machine for Manufacturing of Polymer Membran

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**ABSTRACT:** This study details the design and construction of a low-cost spin coater for thin-film deposition. Spin coater is a machine that can evenly distribute a liquid onto a substrate. This prototype spin coater retains several desired spin coater qualities such as the capacity to produce defect-free and uniform thin films, precision in rotation control, and a closed optimised process chamber, among others. The components required to make thin films have been liquefied in a volatile solvent. The system is built here with a dc motor and a simple electronics circuit, allowing the spinning speed to be readily regulated. The spinning speed in this design is up to 3,000 rpm and may be changed manually step by step. This spin coater successfully prepares ZnO thin films through the sol-gel technique. This thin film is made from a combination of zinc acetate dihydrate, ethanol, and di-ethanolamine. Thin film deposition with this low-cost spin coater is a straightforward technology that may be used to create uniform-thickness films.

**KEYWORDS:** Low cost instrumentation, spin coater, thin film, Open source technology, motor driver, Brushless-Motor.

## I. INTRODUCTION

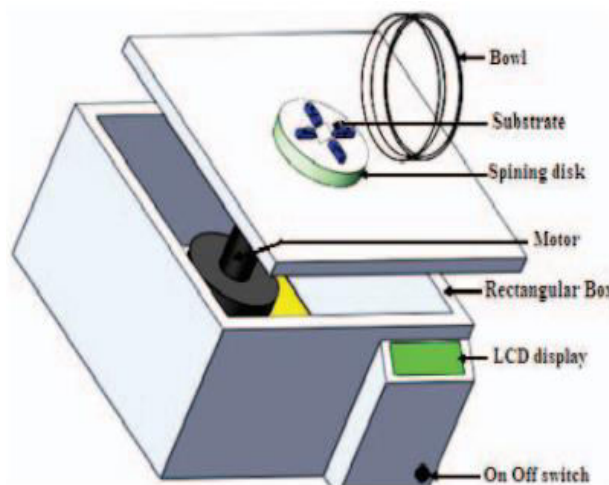
Thin film technology plays an important role in the high-tech industry. The thin film technology was enhanced mainly to fulfill the demand of the integrated circuit industry. Production for the development of smaller, smaller, faster-speed devices, particularly for next generation of integrated circuits, requires advanced materials and new processing technologies useful for integration technology. Thin film as a two-dimensional device is of infinite significance to such real-world problems. The cost of their materials is very low compared to the equivalent bulk content and achieves the same purpose when it comes to surface operations. Awareness and architecture should also be used for the nature of films, for their own functions and their latest functions for designing new technology and future applications. Spin coating is the technique used to apply uniform thin film to a smooth surface. The system used to make thin film is called a spin-coater. These methods are energy intensive which included high temperature, pressure and vacuum. But spin coating is among the most cost-effective, fast and simple ways to deposit thin films and to prepare single and homogenous films. By using fundamentals of physics in the design and development of a low-cost spin coater which can be programmed by computer using the Arduino card and Brushless-Motor.

## II. CONSTRUCTIONS

### A. Construction of the spin coater system

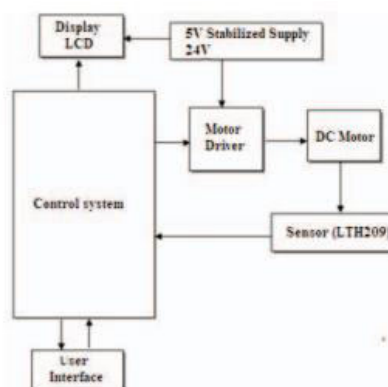
The spin coater model consists of a high-speed DC motor, motor driver, spinning disk, substrate holder, sensor (Infra - red), control system and Arduino card. The user interface communicates with Arduino card and it allows to control the speed and total time of the spinning with push button switches. The control mechanism is responsible for maintaining constant speed and length of rotation according to user selection. It is programmed with Arduino to control the speed of rotation. It gets signals from the user interface, processes the data and it's sends to the Brushless-Motor. The speed of a motor is controlled by adjusting the duty cycle according to the pulse width modulation technique (PWM) of Arduino microcontroller for a range of 0-255 corresponding to a maximum rotation with 3500 rpm. To screen the selected parameters, the programmable Arduino card, combined with a liquid crystal display (LCD), is capable of displaying any character with ASCII values ranging from 0 to 255. The circuit shielding attaches the Arduino to the DC motor. In order to control the speed of the motor with the output of the PWM Arduino platform used and IR sensor as a tachometer to measure output in rpm. This sensor is designed to sense a difference in the black and white surface of the

target that covered the motor axis. The circuit manufacturing and the engine are mounted inside a box with a flat disk attached to the motor axis with a pulley. The plane of the disk should be precisely perpendicular to the spinning axis in order to prevent rocking the substrate while spinning. The substrate can be attached to the supporting disk using a small piece of double-sided adhesive tape. In order to keep the solution from being sprinkled and the film deposition from undesired air currents isolated, a coated Petri dish was adapted to enclose the spinning substrates. The sensor was located on the holder and 15 mm from the reflective object connected to the spinning spindle of the turbine. On the outside, a convenient configuration with several micro-switches clicks the buttons they used to schedule the speed and time of spinning.



#### B. Block diagram description of the spin coater

The three key elements in the design of the spin coat were the mechanical and electronic sections with the control system. The mechanical component included the support mechanism of the machine, while the electronic part consisted of the use of a DC electric motor (24V) coupled with its driver. The control system is programmed to drive the device; its key component is the ATM 328 microcontroller. The power supply was realized by means of a linear arrangement to supply a controlled DC 24 V used for engine spinning. We used an IR sensor to serve as an input for speed measurement. ATM 328 microcontroller to measure the speed (rpm) indicated by an LCD display programmed with the Arduino platform.



Block diagram of the realized spin coating machine.





Spin-coating device

ZnO thin films for different speed and time.

In the future, it is conceivable to make the Spin Coater more user pleasant by adding features such as creating a microcontroller-based digital spin coating system, digitally controlling the motor speed step by step procedure, and using an LCD display unit to indicate spin time, spin speed, and so on. It is possible to improve the user experience of the Spin Coater in the future by adding features such as developing a microcontroller-based digital spin coating system, digitally managing the motor speed step by step, and employing an LCD display unit to indicate spin time, spin speed, and so on.

### III. CONCLUSION

Spin coaters are excellent instruments for preparing thin films. The entire spin coater mechanism is relatively easy in this case. The spin-coating approach is used to successfully manufacture ZnO thin films in this study, employing a simple and convenient chemical approach. This spin coater may also be used to deposit films of several types of precursor solution. So that the problem of high spin coater instrumental costs can be solved, a simple spin coater prototype is designed here; in this work, the easily implementable equipment is developed in Bio mechatronics laboratory and it could be used for the production of thin films using recycled electronic components.

### IV. DISCUSSION

Spin coating is a basic and easy procedure, but it must be done with care to produce a homogeneous thin film. It is surrounded by a glass plate to prevent solution dispersion and to isolate film deposition from unwanted air current. The disc plane that supports the substrates must be absolutely level with the horizontal, and the substrate must be clean and dust-free. Otherwise, the film will be inconsistent. They provide a good step-by-step technique for accurate and uniform deposition of thin films and coatings due to the devices' compatibility and ease of operation. There are various initial conditions that must be satisfied in order to create a superior thin film using the thin film deposition process. Because the disc in a spin coater supports the substrates, it is critical to first ensure that the disc is absolutely level with the horizontal. The depositing solution is contained within the substrate. As a result, it should be established that the substrate must be moist with the depositing solution appropriately, it will separate off the substrate, leaving no trace of material on the substrate. The surface of the substrate should be flat. Its flatness and/or roughness factor may have an impact on the deposition procedure. The depositing material solution should be homogenous and homogenous, with no lumps or air bubbles. It should be checked that the substrate has been thoroughly cleansed. The flow of the solution on the substrate during rotation is optimal for a given spinning speed and solution concentration. It is important to consider whether or not this relationship will be sustained. Otherwise, viscosity may constitute a stumbling block to flow. During the spinning of the substrate, fluids flow up to the substrate's edges. The substrate will continue to spin until the appropriate film thickness is achieved. The solvent used is generally volatile and evaporates at the same time. The thickness of the film is related to the angular spinning speed. The concentration of the film is another aspect that influences its thickness. Spin speed is a critical parameter in a spin coating system. The spinning speed of the substrate influences the amount of radial, or centrifugal, force given to the liquid solution, as well as the velocity and



characteristic turbulence of the air immediately above it. The acceleration of the substrate toward the final spin speed can also have an impact on the characteristics of the coated film. The thickness of a film is determined by a variety of variables. To get homogenous films, numerous factors must be addressed, including solution viscosity and concentration, solvent evaporation rate, spinning speed, and spinning duration.

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