



FABRICATION OF A LOW-COST ELECTRONIC SWITCHING DEVICE

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INTRODUCTION

Switching devices are used in many applications from basic circuits to the most advanced devices. Technological developments create new requirements and invite us to new challenges. The recent crisis in the electronics industry emerges the requirement for materials other than silicon or materials that can be purchased easily. In this field, thin-film technologies for micro/nanosystems are used to overcome these new challenges. Integrated chips can be built with these technologies.

This project aims to produce a low-cost switching device made up of zinc oxide and cuprous oxide by utilizing thin-film technologies. This study is one of the firsts in Turkey at the undergraduate level to successfully produce such devices.

DEVICE DESIGN

In the production phase, an n-type semiconductor material, zinc oxide (ZnO) is deposited onto an ITO coated glass. On top of this, a layer of p-type semiconductor material, cuprous oxide (Cu_2O) is grown. After these processes, circuit topologies are formed by laser engraving techniques.

Project results show that the switching device made up of zinc oxide and cuprous oxide materials is just as efficient as the commercial ones. Being low-cost and producible in a vacuum-free environment, such devices can be of great use for the future of the electronics industry.

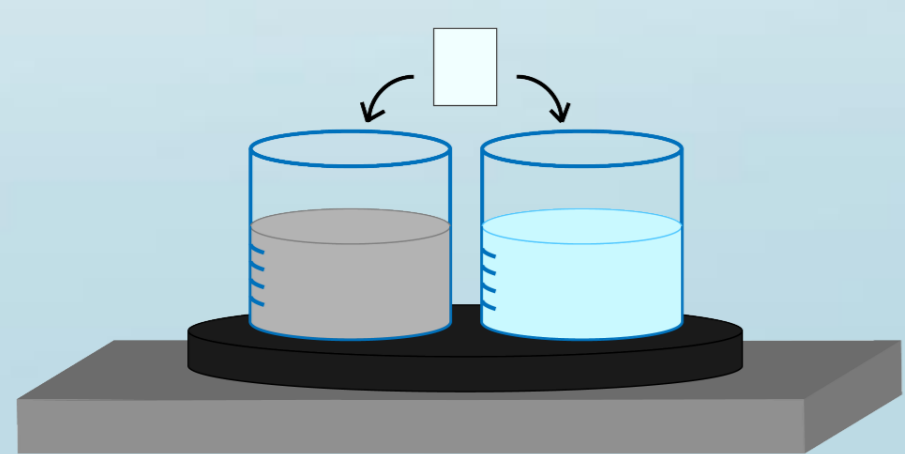
METHODOLOGY

A diode is known to conduct current in one direction. This behavior of the device can be utilized to construct basic logic circuits. These devices are generally produced using p-type and n-type doped semiconductor materials such as silicon and germanium. Conventional production techniques require huge investments to produce these devices.

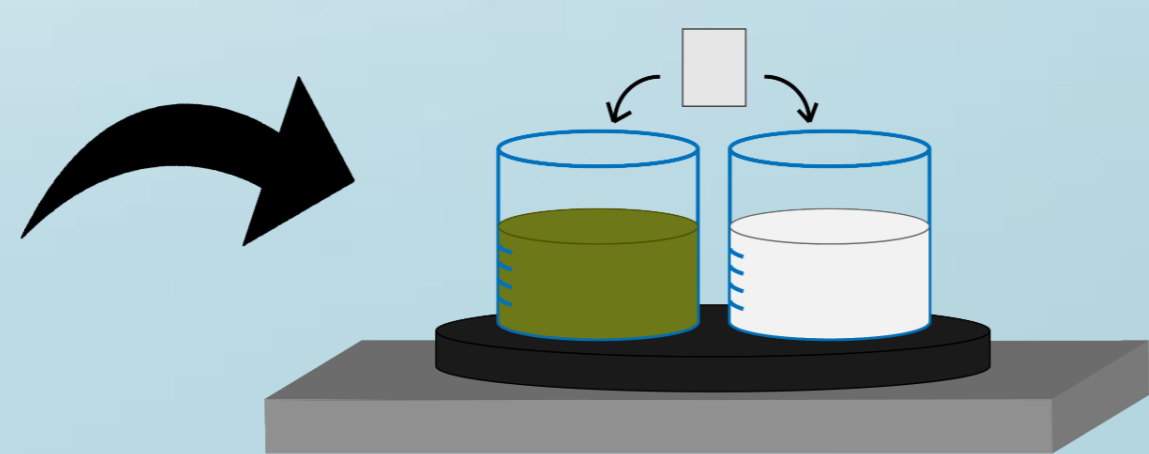
Advantages of thin-film devices are less energy consumption, improved chemical resistance, creating a barrier to gas penetrations, and being way more ecological than commercial products.

In this study, electroless thin film deposition methods are used to lower production costs. Chemical bath deposition (CBD) is chosen as the electroless deposition method which uses several beakers and chemical compounds to obtain a low-cost coating. Laser engraving techniques are utilized to implement different device geometries.

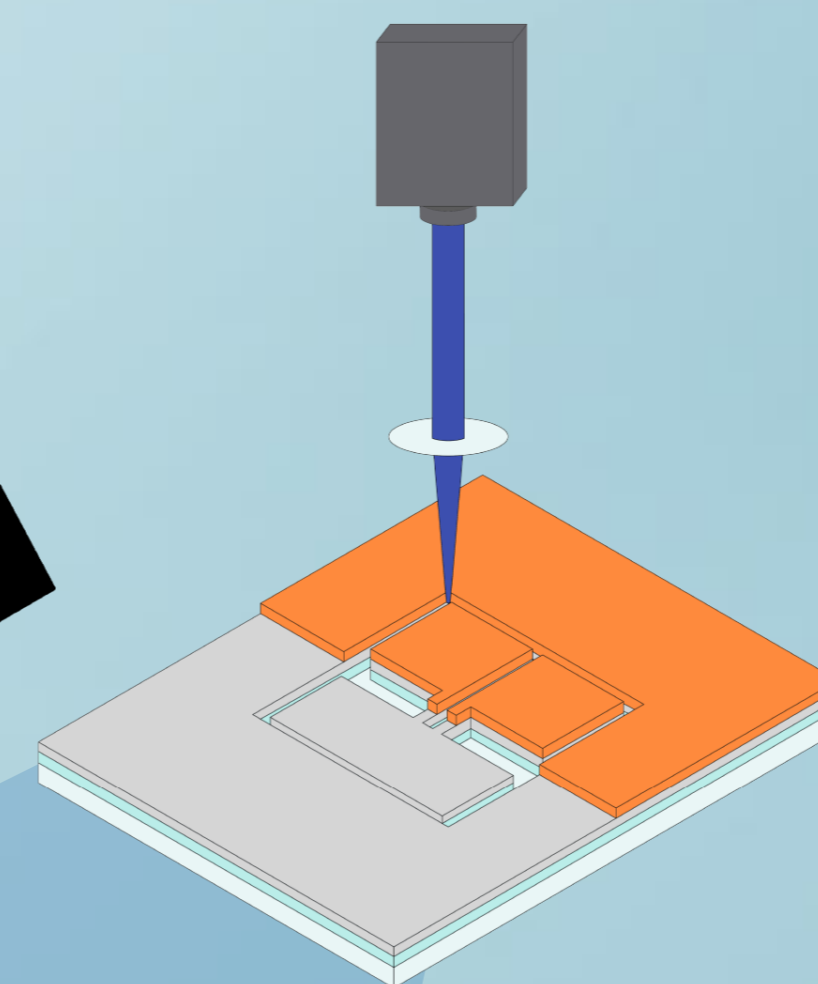
Switching devices produced with this low-cost method can be used in a wide range of application areas including radar and cellular phone receivers, satellite communications, AC to DC converters, and basic logic circuits. A logical OR gate is constructed with the switching devices produced in this project as a successful application.



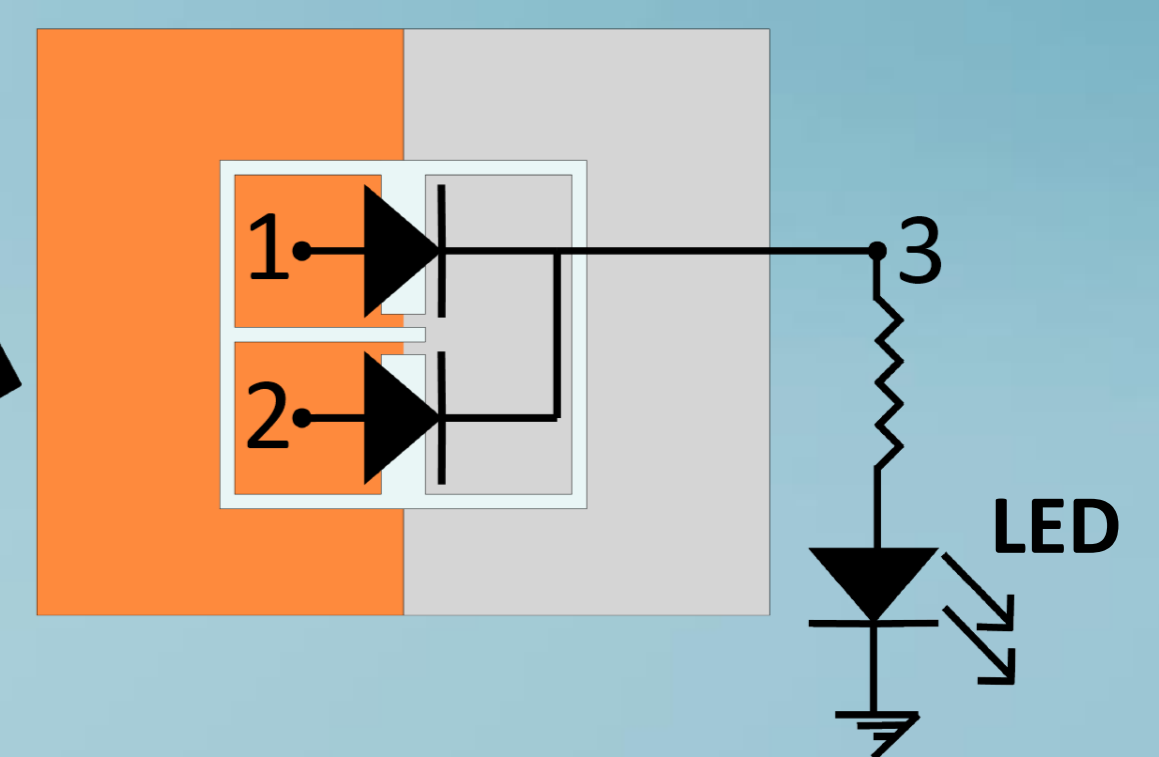
Step1: Zinc oxide deposition using distilled water and sodium zincate solution



Step2: Cuprous oxide deposition using sodium hydroxide and sodium thiosulfate/copper(II) sulfate solution



Step3: Laser engraving to obtain different device geometries



Step4: Setting up the device for logic operation

