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Design and Fabrication of handmade screen printing for thin film applications

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Abstract*—The aim of this work is design and fabricate a screen printer for depositing TiO_2 thin films from TiO2 paste. Screen printer system has been prepared by wood frame and silk screen. TiO2 paste is prepared with the help of TiO2 powder. The size and shapes of each thin film has been exactly same as the mask of screen printer. The mask and prepared thin film have been compared and investigated in this work.*

1.Introduction

With ever-increasing political and economic oil conflicts as well as climate change, a growing need for renewable energy that comes from natural resources, such as sunlight, wind, rain, tides and geothermal heat, is warranted. Wars have been caused in part to protect oil supplies, and millions of tons of pollutants and greenhouse gases are emitted into the atmosphere every year due to the burning of fossil fuels to create energy. There is no other area of technology than renewable energy technologies that can both "meet the challenges of climate change and secure an energy supply in an intelligent manner" [1].A number of options for new technologies of renewable energy exist, that is, from geothermal to wind to hydrogen fuel cells to hydropower; however, one of the most accessible and widely used technologies is solar energy. Solar power does not create any noise when it is working, "is non-polluting, does not generate greenhouse gases, and creates no waste products,"[2].which is also why it is an increasingly preferred renewable energy. Additionally, the potential for solar power is immense [3].

This is why, a project has been gone to implement to develop solar cell by using screen printing process. By screen printing process thin film can be produced. A thin film is a layer of material ranging from fractions of a nanometer to several micrometers in thickness [4]. Electronic semiconductor devices and optical coatings are the main applications benefiting from thin-film construction. A familiar application of thin films is the household mirror, Work is being done with ferromagnetic and ferroelectric [1] thin films for use as computer memory. It is also being applied to pharmaceuticals, via thin-film drug delivery. Thin-films are used to produce thin-film batteries. Thin films are also used in dye-sensitized solar cells[5]. In recent years, the manufacturers of thin-film solar modules have brought costs down and gained competitive strength through advanced thin film technology.

Screen printing method is far better than other method such as sol-gel method, sputtering method .By using screen printing process, sixteen cells of dimension 2x2cm,42 cells of dimension 1x1cm and 133 cells of dimension 0.5x0.5cm are made on glass plate of dimension 10x10cm.This is because, a quite large number of cell can be produced economically at a time by using screen printing method. But by sol-gel method and sputtering method cannot produce more cells at a time .Sol-gel can produce one cell at a time.

When it comes to creating many copies - When it has to make copies in a wholesale quantity, screen printing is the right option. The solar panels are going to used again and again if we are going to make many copies. It is an economical way and works out cheaper [6]. Cost recovery becomes easier and we would end up making good profits. Screen printing is a quick process as compared to other methods of advertising. When our advertisement is viewed by millions of prospective customers, it would definitely convert some of these prospects into your clients. The process of screen printing is simple and hassle free[7]. The only requisites are

the screen panels and the requisite materials. With these, we can kick start our business. The colors dry quickly and you could start showing the ads to the targeted audience [8].

When it comes to larger designs, screen printing is the ideal choice. We can choose to be more creative and resourceful when it comes to selecting the screen panel's size. It is possible to make larger counterparts of the design, without any distortion to the texts and images. When it comes to digital printing, it is not very easy to make adjustments. Wide range of utility - Screen printing can be used effectively for a variety of things. Screen printing is used for printing designs on clothes, fabrics and garments. It also caters to printing on product labels, printing of circuit boards, adding different designs to balloons etc[9].In this work Screen printing system has been degined and fabricated with the help of wood frame and silk screen.TiO2 films has been deposited on glass substrate by this screen printer with different size and shape. Overall screen printing process has been discussed in this work.

2.EXPERIMENTAL SECTION

First step: Wood frame

Involves a screen of woven material such as synthetic fiber that has been glued to a wood frame under tension.

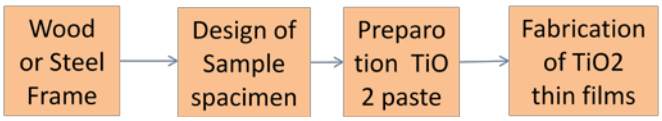

Figure1: Schematic block diagram of different for whole screen printing process

Second step: Design of sample specimen:

Silk is filled with a coating solution by squeegee. Then it is made dehydrated by dryer machine .After that the desired output which we want is printed in tracing paper by using computer .The tracing paper is placed for 5 to 10 minutes on the silk screen and placed it in a sunny place for few minutes . After this time the tracing paper is withdrawn. Then we get the desired design.

Third step: Preparation of TiO_2 paste

TiO2 nanostructure films were deposited on glass by using a screen printer.TiO2 paste were prepared as follows: 0.5 g of TiO2 powder was mixed with 0.1 ml of acetylacetone, and was grounded mechanically. During vigorous stirring, 4 ml mixture of water and ethanol (1:1, in vol. %), and 0.4 ml of Triton X-114 were added.

Fourth Steps: Fabrication of TiO_2 thin films

At first the wood frame is placed on a glass substrate and after that the solution(TiO_2) is placed on screen and a squeegee is forced on the screen and then drawn linearly across the screen thus forcing coating solution through the open areas onto the substrate and at the end desired output on a glass substrate.This diluted paste was used for the TiO_2 coating on the glass by the use of a screen printer. Then by this process cell pattern can be reproduce 2x2cm and 1x1cm onto a glass .

3. RESULTS AND DISCUSSIONS

Figure 2 (a) shows the mask pattern of 2x2 cm for 16 pieces of samples. The vertical and horizontal Space between two nearest thin films is 0.4cm and 0.5cm, respectively. Figure 2(b) exhibits the picture of prepared TiO_2 films on glass substrate. The dimension of glass substrate is 10x10cm² and thin films is covered space is 8.5x8.8cm² on the same glass substrate. TiO2 films also recovered space is 8.5x8.8cm².

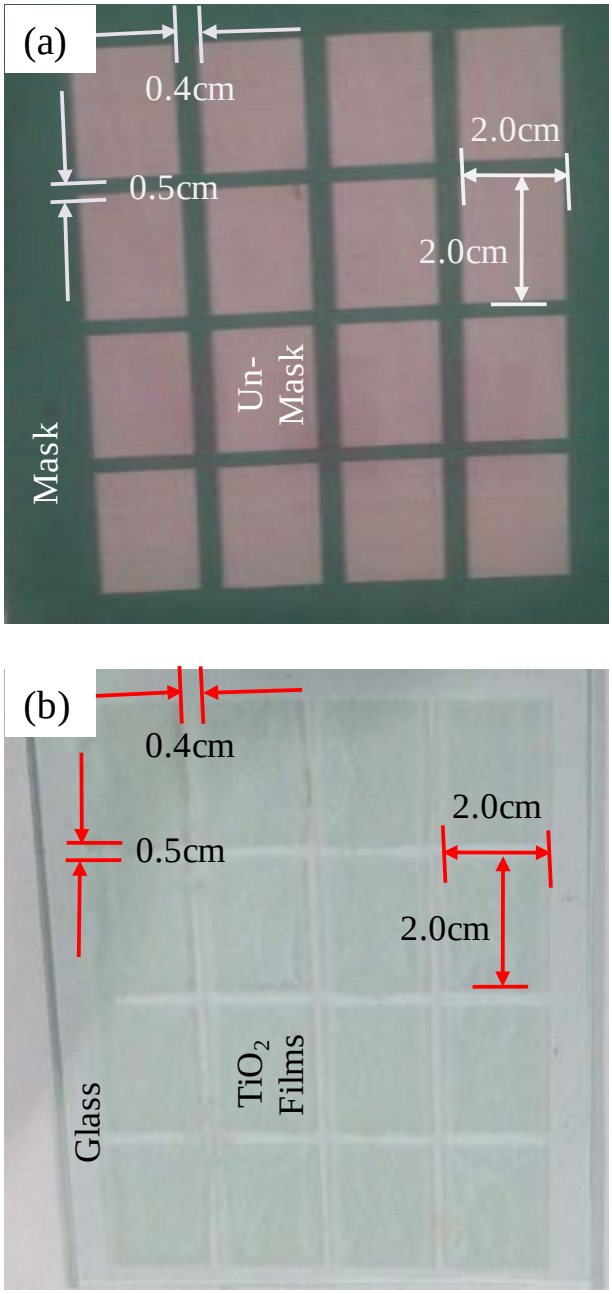

Figure 2: It is a design for screen printing process

Figure 3(a) shows the mask pattern of 1x1 cm for 42 pieces of samples. Vertical and horizontal Space between two nearest thin film is 0.2cm and 0.4cm . Figure 3(b) shows picture of TiO2 films on glass substrate. The made TiO2 thin films is transparent because the line "EEE RUET" bellow the thin film glass substrate is shown. So the TiO2 thin film is transparent from figure 5 .The dimension of glass substrate is 10x10cm² and cell recovered space is 8x8.8cm².TiO2 films also recovered space is 8x8.8cm².

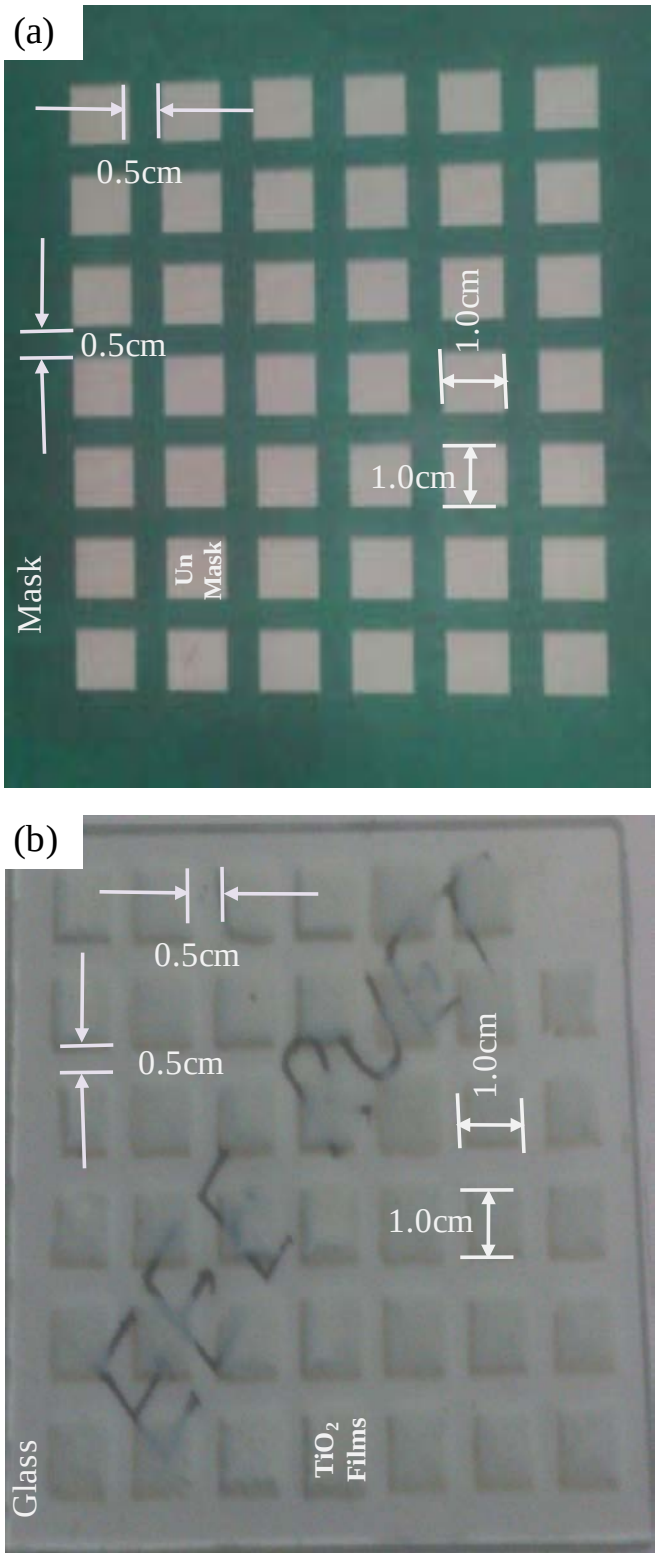

Figure 3: It is a design and fabrication of thin film of screen printing process[14] .

4.Conclusion

For the above process, screen printer was made successfully by silk screen and wood frame.TiO_2 thin films have been deposited on glass substrate by using screen printer with various dimensions of 1x1cm and 2x2cm specimen. Sixteen TiO_2 thin films with dimension 2x2cm here is in the single glass substrate. Also forty two cell with dimension 1x1cm has been prepared by the same procedure. The space between two thin film has exactly same as the mask. This manual process can be modified in future by using computerized or microcontroller based automatic system. This screen printer may be used for large scale application by increasing the size and shape of the specimen. More over this screen printing is very cheap, quick process and very easy to use. It is an economic process and by this process solar cell can be made easily.

Figure 4:Design of screen printing process [10]

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