

Development of Solar Cells and Future Fashion Smart Bags and Clothing with Scrap of Pattern Technique

Yong-Ho Kim, Gul-Won Bang

Abstract Background/Objectives: *The difficulty lies in the connection of various design product when applied the outward form of bags and cloths due to the big rectangle shape of existing solar cells.*

Methods/Statistical analysis: *Development of solar cell scrap design and application of pattern design in fusion of fabric are utilized as the patterns of various scrap design were surveyed and each design was classified as well as researched.*

Findings: *Upgrade of solar cell makes it possible to be able to promptly apply to the product design. Applied customized logo surface lighting in the solar cell jumper and vast is not only satisfied needs of user's self-expression but also secured the stability of outdoor activities in the night time. Expanded product of solar cell bags as well as expansion of user area and new concept of functional backpack such as solar cell charger, sterilization and lighting are newly developed. Integration of convergent fabric material which is combined solar cell with textile is also developed to utilize bags and clothing in this study.*

Improvements/Applications : *It is anticipated that product family in solar cell charger which is promptly applied to solar cell scrap due to its design is expanded. Revitalizing domestic solar cell market and expansion of activities are expected in the future according to the expansion of product family. Creation of new market with collaboration with IoT and fashion is also expected.*

Keywords: *Solar cell, FashionBag, Smart Fashion, Future Energy, Convergent Fabric, Eco-friendly Energy*

I. INTRODUCTION

Rectangular type of inductile solar cell is not easy to turn inside out when in manufacturing products and the frequently occurring defects are wrinkles and brokenness due to effects of laminated coating when it applied a small anthropogenic forcing. These make it difficult to apply various design product when in combing solar cell with bag and clothing [1,2]. There is a limitation to install a specific part especially front part of bag due to configurational characteristic. Owing to the uniformity of its panel, fixed panel type products which look like solar cell product consist largely of market. The design vulnerability of solar cell panel can also lead to degrade aesthetic product and bag design in solar cell[3,4]. Solar cell module of constant size through

joint process of series-multiples connection in each scrap is manufactured to develop triangular type of solar cell panel for the purpose of combination of each panel scrap to make pattern design with fixed rules[5,6].

Integrated converged fabric material is developed in this study as the best practices among three way such as laminating, bonding and stitching is provided to attach produced solar cell to fabric(mesh or lining material) [7,8].

II. RELATED STUDY

Cases of collaboration between IoT technology and fashion industry are very much on the increase recently according to analysis of not only smart fashion market trend but fashion accessories and combined fashion but functional product market. Products such as a LED light on the emblem placed on the bag based on NFC/Bluetooth technology will be flickering in case of phone calls and applied LED lighting design and utilization of solar heat in clothing as well as outdoor product will actively discussed and studied lately. The product which is supplied by diversified methods of solar cell application shows a variety according to analysis of solar cell which is applied to bag, clothes fashion and hiking outfit. In case of fashion and miscellaneous good, the design is still rectangular even though the panel may small or large square board type. This is a current picture of it that generates small amount of power. China and the United States do receive the most solar bag product which is activated by solar cell, however the excellence of its design and collar is low[9,10]. Solar film which was registered patent by Jeilmojik, Korea company, in 2013 was applied a bag which was able to not only charge multiple electronic devices at the same time but identify charging condition in real time. According to survey and analysis of domestic and foreign market size as well as their trend, it will be expected that the fashion market size has increased by over ten percent annually. Investment size is also expected accordingly to be increased[11,12].

Problems have been encountered while applying bag is applied to an existing solar cell with limitation of flexibility and design. Patterned scrap of solar cells makes it possible to make bag that is not fixed shape. A use of the product is bag and clothing that are closely used in real life. They are considered as future fashion goods that fit new fashion trend. Design of solar cell scrap is made based on traditional Korean pattern. Solar cell scrap pattern for exploring

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examples that drive its design in this study is shown in Figure 1. Pattern that has fixed rule is designed to create a free-form shape such as triangle, pentagon, and hexagon.

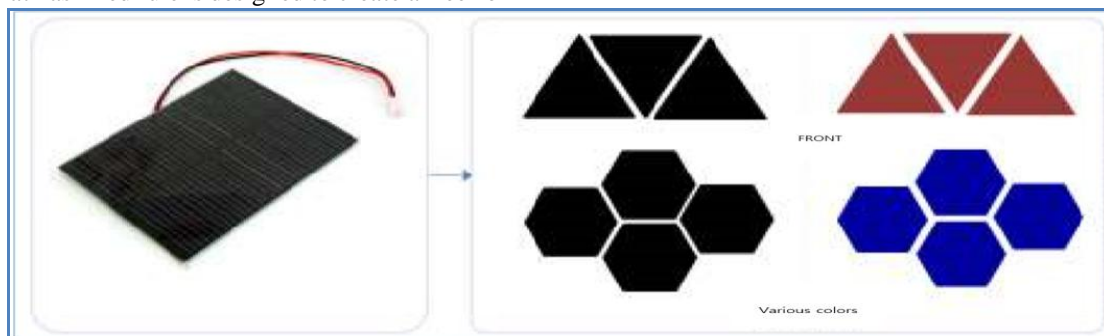


Figure 1. Solar cell change according to color of filler

laminating is adapted again in the front part

III. DEVELOPMENT OF FABRIC APPLIED SOLAR CELL

Solar cell with scrap pattern is developed as follows ; it is placed manufactured mold over scrap solar cell and spread a bag fabric in the pattern, and Connection between FPCB circuit and cell, After laminating with mash fabric on top,

3.1. Basic design in solar cell panel scrap

Specification like Table 1 is designed for diversity of fabric design. Target efficiency is set up for 75% owing to difficulty of the maximum efficiency in a solar cell. That makes practical recharge to be designed.

Table 1. Size specification of designed solar cell

Shape	Number	solar cell		Material		electric power(w)	electric power(w) 75 %Efficiency
		Minimu m voltage	Minimu m current	Minimu m voltage	Minimu m current		
a regular triangle	288	0.5	0.04	5	1.4	7.2	5.4
square	200	0.5	0.05	5	1.6	8	6
isosceles triangle	200	0.5	0.05	5	1.6	8	6
Hexagon	91	0.	0.12	5	1.8	9.1	6.8
Octagon	84	0.5	0.13	5	1.8	8.4	6.3

3.2.A design and manufacture of solar cell panel

Each solar cell is designed to have 0.5V, 40-60mA. Design and simulation of panel is conducted to have at least minimum 5.4W output in case of performance of 5V with 75% of efficiency in target fabric. In Figure 2 is FPCB of solar cell with mesh form by serial-parallel is designed to have target output. The advantage of mesh form makes the hazard for breaks lower to able to use bag or cloth not only because each solar cell is tied up very strongly with FPCB but also because it is combine fabric with ease. However, solar cell can be prevented damage while bending could cause some problem if thick protection sheet will be applied solar cell and fabric.

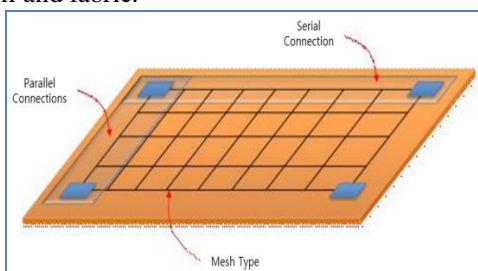


Figure 2. FPCB Design of mesh type solar cell

In case of design of solar cell panel using single FPCB connector like Figure 3, problem can be easily found in case of encountering problem and fabric is so tough that it won't

cut if fabric is folded when it applied to the material of bag and cloth. However, solar cell module that is connected PCB by epoxied solar cell is used because material of solar cell tends to break before laminating between fabric and FPCB

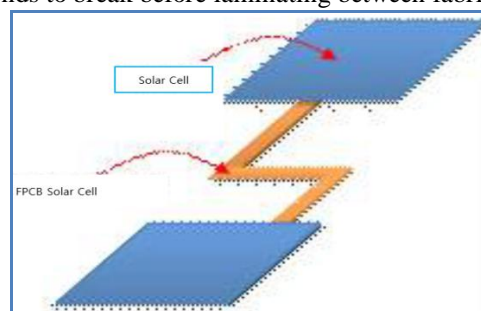


Figure 3. Panel design of solar cell using single FPCB

3.3 Connection of solar cell scrap panel.

Design needs to correspond with fabric purpose because output of each solar cell produces 0.5V with 30~40mA. Serial connection in 10 cells like Figure 4 is designed approximately 5V output and one set with ten cells is connected to 35 set in parallel.



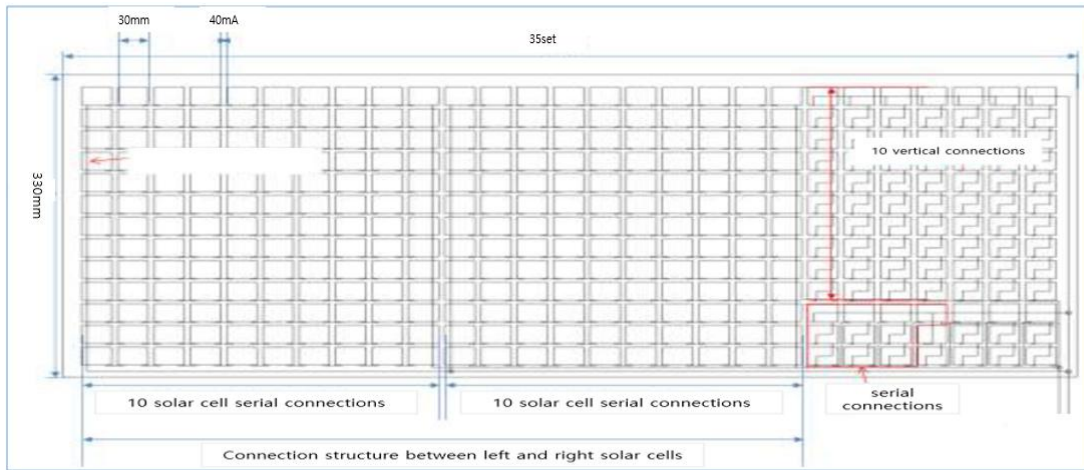


Figure 4. Design drawing of rectangular solar cell panel

3.4 Development of attachment method between solar cell and fabric

Three kind of fabric like Figure 5 was developed to

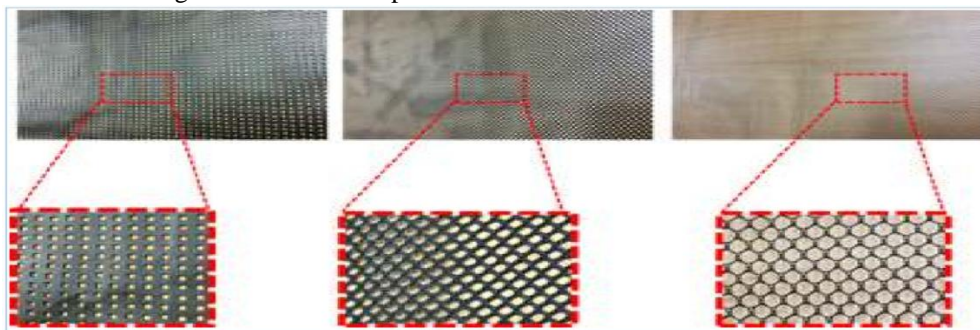


Figure 5.3 Shape and structure in three kind of fabric

manufacture the fabric of using solar cell. Mesh fabric that is easy to process with other fabric meets selection criteria.

3.5 Attachment of solar cell to fabric

Test for attachment of solar cell to fabric was conducted in laminate method, adhesion method and stitch method and attachment method is selected according to evaluation of result.

3.5.1 Laminate method

Test for attachment between solar cell and fabric using laminate method is shown in Figure 6.

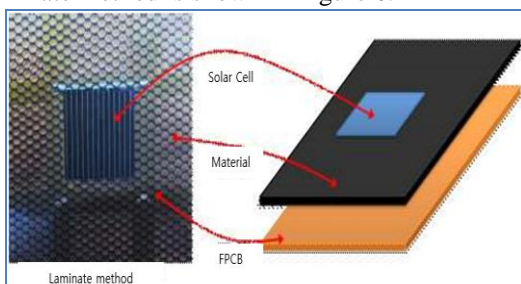


Figure 6. Test for attachment between solar cell and fabric using laminate method

3.5.2. Adhesion method

Test for attachment between solar cell and fabric using adhesion method is shown in Figure 7.

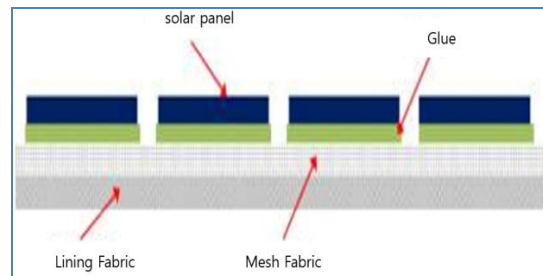


Figure 7. Test for attachment between solar cell and fabric using adhesion method

3.5.3. Stitch method

Two materials are stitched together so the filling or coating is manufactured large enough to not move around when solar cell scrap panel that is applicable stitch method is developed. It is shown in Figure 7.

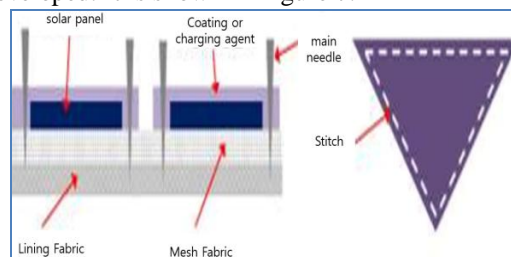


Figure 8. Test for attachment between solar cell and fabric using stitch method

IV. SELF PERFORMANCE TEST OF SOLAR CELL

It has confirmed that total solar cell panel has a capacity of 8.1W with 7.45V and 1.1A shown in Figure 9 because the cell performance was measured in early winter among four seasons in Korea so it was not so high value of amount of solar radiation.

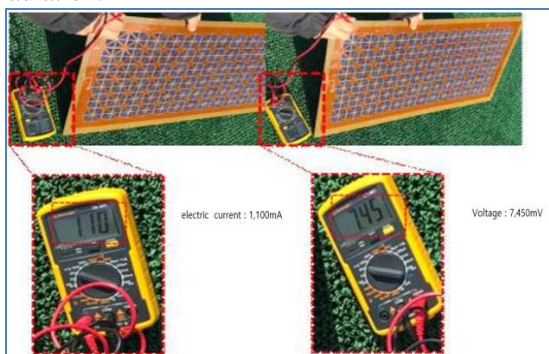


Figure 9. Test result of actual measurement in solar cell panel

It has confirmed that test result of actual measurement in rectangular type solar cell is 5.04V with current in 3.29A. Test was conducted around 10 am with a condition of November insolation. Power was confirmed by 16.58W. It is suitable for fabric applicable to bag or cloth owing to solar cell module with generating 12.43W, then assuming that the efficiency of solar cell is 75 percentage.

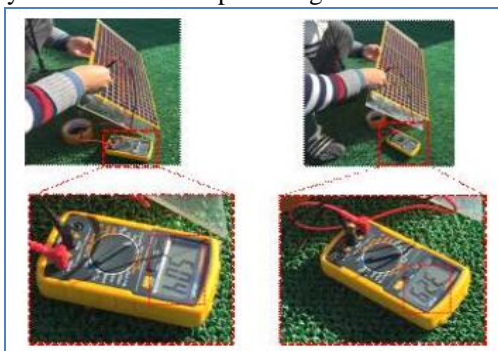


Figure 10. Test result of actual measurement in rectangular type solar cell panel

V. CONCLUSION

Shape of solar cell panel that broke away from the rectangular type can be developed as a triangle scrap in this study to make a certain rules in the pattern with a combination of each piece of scrap. Certain size of solar cell module is manufactured through combination process that each scrap polarity terminal is connected series-parallel. Integrated convergent fabric that combines solar cells with fabric applicable to bag and cloth according to conducting the optimized methods among three ways such as laminating, adhesion, and stitch is developed for attaching solar cell module to fabric (mesh fabric and lining fabric). Design value will be improved by pattern method in solar cells so a wide range of selections is likely to take effect immediately. Fabric itself is expected to have the infinite application because an integrated convergent fabric combined with solar cell scrap using pattern technique is possible not only to have a variety of design change but also

to have flexibility. Design of solar sell scrap with pattern technique makes fabric diverse color as well as pattern. It is expected that new consumer group will be secured owing to a variety of color and pattern comparing to the traditional design. According to expanding product family in solar charger, it is also expected to activate domestic market of solar cell product.

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