

# TCO-free High Flexible Fabric Dye-sensitive Solar Cell Based on Metal and Ceramic Fibers

Sung Il Cha, Min Ju Yun and Dong Yoon Lee\*

Nano-hybrid Technology Research Center of Korea Electrotechnology Research Institute  
641-120 Changwon City, Kyungnam, R of Korea

Yong Sung Lee

Songitextile Co., Ltd., Daegu City, R of Korea

New type of high flexible DSSC based on weaving technology using metal and ceramic fabrics has been developed and prepared for commercialization in pilot plant scale. The new fabric cell has high flexibility, light weight, high mechanical durability and low manufacturing cost. Its efficiency is about 5 % and is preserved with 80 % of starting efficiency after 90° bending test of 2,000 times. And more, the minimum bending radius in operation is only 0.4 cm and this means that the cell can be enough bendable for the normal wearable devices.

The main concept of fabric DSSC is primarily to remove transparent conducting oxide (TCO) substrate, which is severe barrier to make flexible cell, by adopting fabric structure. In this structure metallic fibers are weaved as large area fabric and used as the electric conductor of electricity generated in dye-adsorbed TiO<sub>2</sub> electrode instead of TCO. This metallic fabric substrate has beneficial merits something like high flexibility and needlessness of metallic grid for preventing voltage drop found in large area module. The counter electrode of nano carbon base is also coated on the metallic fabric. For the electrolyte the ceramic or polymer fabric are layered between the photo-anode and the counter electrode, and the liquid or solid electrolyte can be absorbed in this fabric layer. Like these, all layers of DSSC can be fabricated as 3D-multi layer fabric in the special weaving machine. We have developed the fabric pattern for high efficiency, weaving algorithm for mass production, manufacturing processes, materials and manufacturing machines realizing all fabric DSSC above 5 years. Especially we have been engaged in computer simulation for long time because there are too much variants and conditions in fabric process and we had to find optimum condition for high performance. The simulation results of efficiency and fabric pattern are well suited to our experiments.

In manufacturing process we cannot use the traditional process and equipment for making fabric DSSC. For example the normal screen printing method with base plate is not usable because the paste gets out through the porous fabric and sticks to base plate. We had to make the new coating process called as floating substrate deposition (FSD) and its machine. Materials also should be modified for the fabric cell. Especially we prepared the interesting new type of solid electrolyte which was easily infiltrated through TiO<sub>2</sub> porous structure and then stabilized under the high bendable conditions. We will show these results and commercialization state in this conference.