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# Study of Mechanical Properties of Large Scale Flexible Silicon Solar Modules on the Various Substrates

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**Abstract :** Crystalline silicon (Si) solar cells are the main product in the market among the various photovoltaic technologies concerning such advantages as: material richness, high carrier mobilities, broad spectral absorption range and established technology. However, photovoltaic technology on the stiff substrates are heavier, more fragile and less cost-effective than devices on the flexible substrates to be applied in special applications. The main goal of our work was to incorporate silicon solar cells into various fabric, without any change of the electrical and mechanical parameters of devices. This work is realized for the GEKON project (No. GEKON2/O4/268473/23/2016) sponsored by The National Centre for Research and Development and The National Fund for Environmental Protection and Water Management. In our work, the polyamide or polyester fabrics were used as a flexible substrate in the created devices. Applied fabrics differ in tensile and tear strength. All investigated polyamide fabrics are resistant to weathering and UV, while polyester ones is resistant to ozone, water and ageing. The examined fabrics are tight at 100 cm water per 2 hours. In our work, commercial silicon solar cells with the size 156 × 156 mm were cut into nine parts (called single solar cells) by diamond saw and laser. Gap and edge after cutting of solar cells were checked by transmission electron microscope (TEM) to study morphology and quality of the prepared single solar cells. Modules with the size of 160 × 70 cm (containing about 80 single solar cells) were created and investigated by electrical and mechanical methods. Weight of constructed module is about 1.9 kg. Three types of solar cell architectures such as: -fabric/EVA/Si solar cell/EVA/film for lamination, -backsheet PET/EVA/Si solar cell/EVA/film for lamination, -fabric/EVA/Si solar cell/EVA/tempered glass, were investigated taking into consideration type of fabric and lamination process together with the size of solar cells. In investigated devices EVA, it is ethylene-vinyl acetate, while PET - polyethylene terephthalate. Depend on the lamination process and compatibility of textile with solar cell an efficiency of investigated flexible silicon solar cells was in the range of 9.44-16.64 %. Multi folding and unfolding of flexible module has no impact on its efficiency as was detected by Instron equipment. Power (P) of constructed solar module is 30 W, while voltage about 36 V. Finally, solar panel contains five modules with the polyamide fabric and tempered glass will be produced commercially for different applications (dual use).

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