

INVESTIGATION OF SOLAR CELL STRUCTURES AFTER LASER BEAM PROCESSING

Neděla Vilém¹, Bařinka Radim², Hladík Jiří², Flodrová Eva¹

1. Institute of Scientific Instruments ASCR v.v.i, Královopolská 147, 61264 Brno, Czech Republic

2. Solartec, s.r.o, Televizní 2618, 75 661 Rožnov pod Radhoštěm, Czech Republic
E-mail : vilem@isibrno.cz

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Crystalline silicon solar cells represent one of the most rapidly developing alternative energy sources in the world. One of the significant quality improvements in the production of solar cells was achieved by the use of laser technologies, which are actually widely used for many applications.

In this study we compare surface structures of crystalline silicon solar cells machined by two different types of laser systems. The first type of laser system is represented by a classical fiber infrared laser and the second type is a special laser MicroJet system using a unique technology patented by Synova Company [1]. The working principle of this system is based on a combination of a water jet and laser beam, where a focused laser beam is reflected on an inner side of a water jet and after multiple total reflections it is guided in the direction to the machined material up to 100 mm without losing guaranteed parameters.

Cutting profiles, holes and grooves in crystalline solar cells created by infra red laser and MicroJet laser at the different power of laser beam and cutting speed were inspected by a microscope LEXT OLS-3100, which is a 408nm laser-based confocal microscope for nondestructive imaging and measurements of submicron surface structures with magnifications as high as 14,400x. For additional surface characterization, environmental scanning electron microscope AQUASEM II was used, designed in the Institute of Scientific Instruments (ISI) of the Academy of Sciences of the Czech Republic [2]. One of the main advantages of this microscope is the possibility to study nonconductive samples free of charging artefacts using a special ionisation detector of secondary electrons and highly efficient YAG detector of backscattered electrons. With the resolution of approximately 10nm for the water vapor pressure 500Pa and accelerating voltage of a primary electron beam 30kV. In combination with optical and electron microscopy, this work enables the characterization of the structure of solar cells processed by various laser systems. Obtained results allow determination of the level of possible defect creation caused by the powerful laser beam. This work also shows the advantages of the water jet-guided laser system MicroJet in the production of solar cells, especially its ability to guarantee very precise and clean machining of solar cells without their additional temperature damage and free of impurities along a machined edge.

[1] See <http://www.synova.ch>

[2] NEDĚLA, V., Dynamical „in situ” observation of biological samples using variable pressure scanning electron microscope, J. Phys.: Conf. Ser. 62, 1–4.

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