EFFECT OF TEMPERATURE ON A MONO-CRYSTALLINE SOLAR PANEL

UTICAJ TEMPERATURE NA MONOKRISTALNI SOLARNI PANEL

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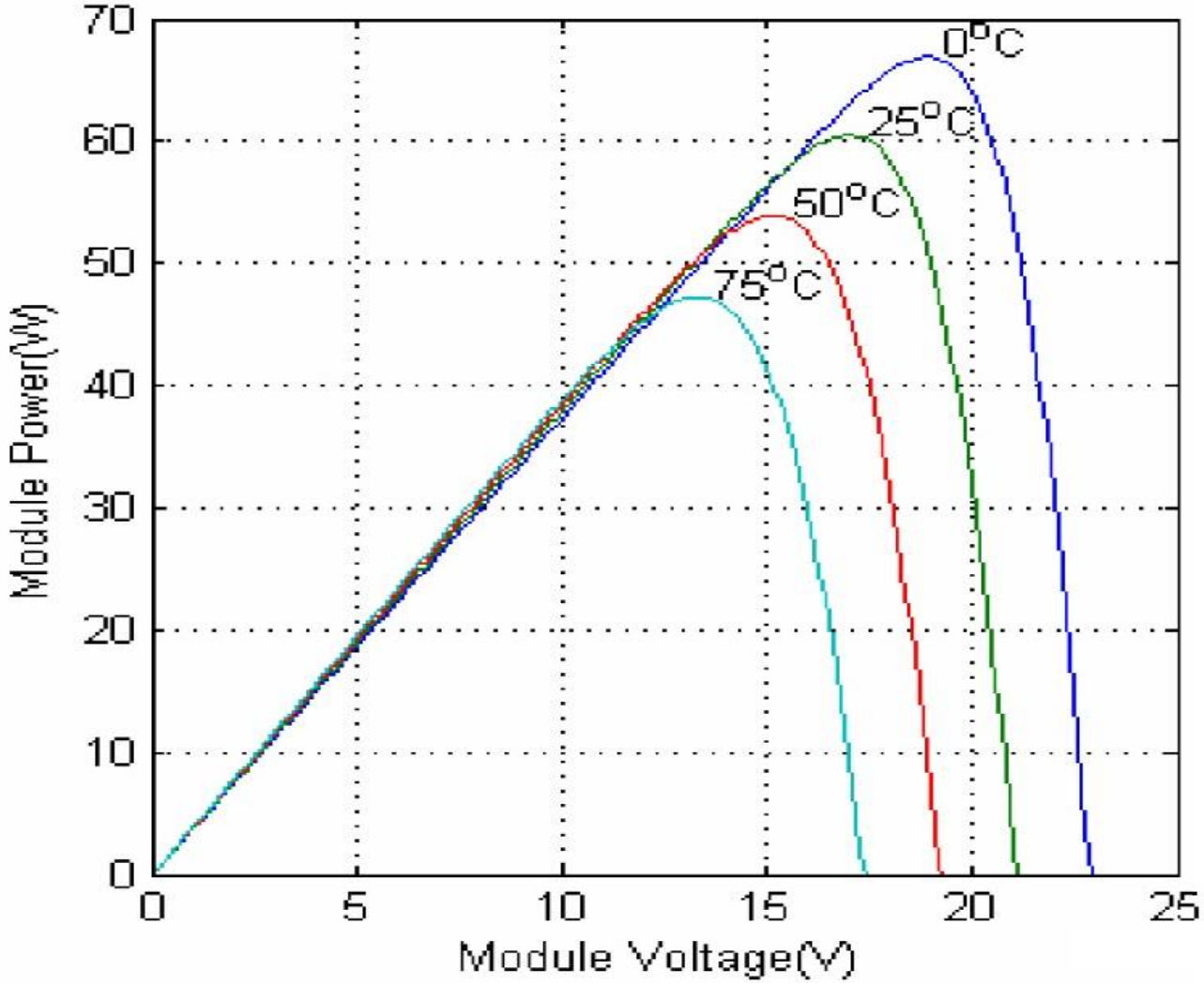
Introduction

One of the most important factors affecting the operation of photovoltaic cells is temperature. Solar radiation is highly absorbed into the body module. Part of this energy is converted into electricity and transferred to the consumer, but also the part of the energy is converted into internal energy of the material itself, and thereby it led to the increase of the cell temperature.

PV curves at various temperatures and constant irradiation of G=1000W/m²



From the Figure 1. it can been concluded that the efficiency of solar cells significantly decreases with temperature. On the other hand, the cells are heated also due to solar radiation and due to current flow, therefore the higher efficiency can be achieved by cooling the pad. Additional gains can be achieved by utilization of excess heat for heating or electricity generation using thermoelectric modules.

EXPERIMENTAL PART

› Experiments of a series of monocrystalline photovoltaic panels in different conditions have been conducted. For larger panels, individual cells were tested, in order to have always the same radiation power on a given surface. As a source of radiation, semiconductor lasers power from 0.5 to 2W were used, with different wavelengths in the visible spectrum.

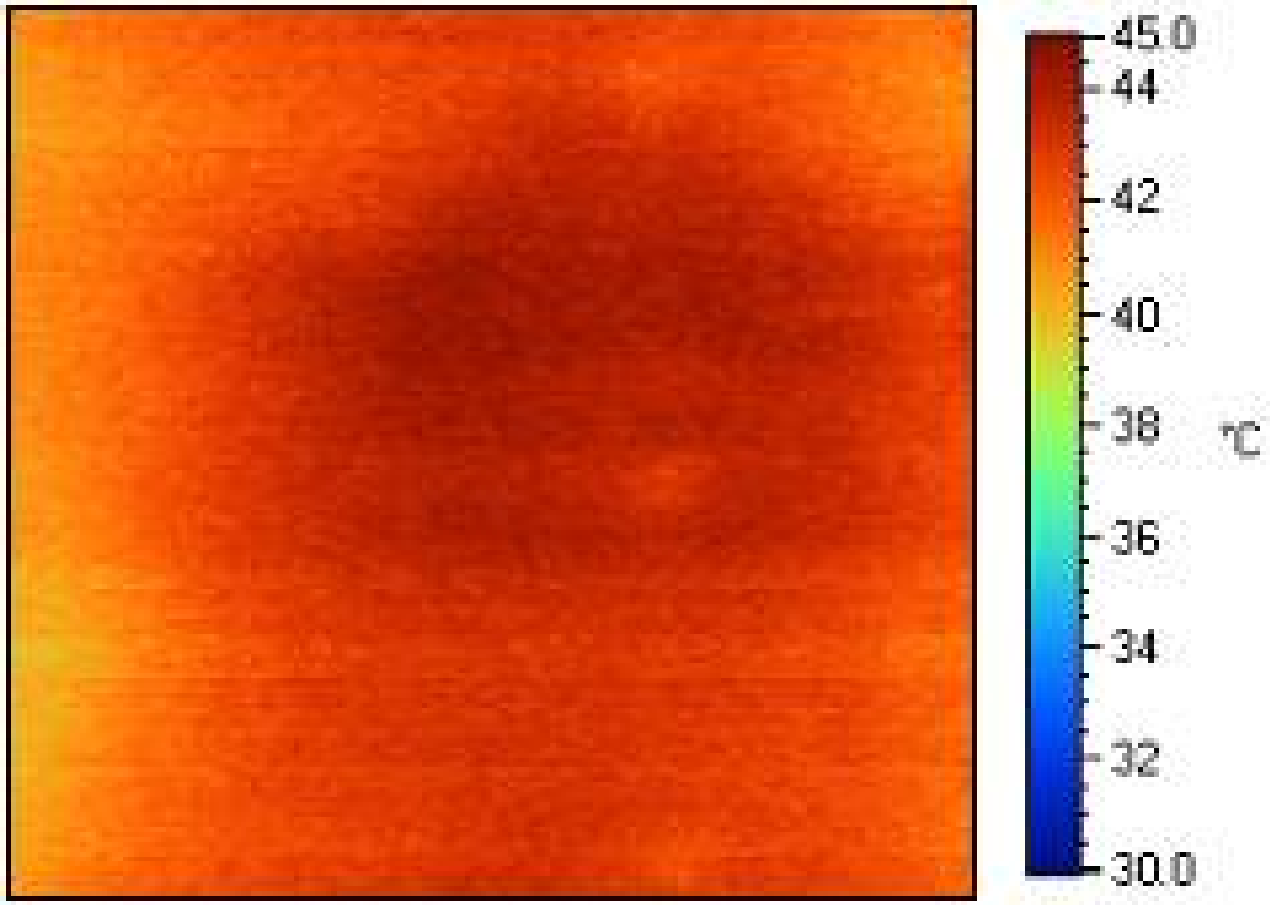
To monitor the temperature and homogeneity of heating, the digital thermal imager Flir E8 was used. The E8 is a long-wavelength (7.5-13μm) uncooled microbolometer camera with a resolution of 320 x 240 pixels and thermal sensitivity <60mK. Digital video data were transmitted through an USB adapter to a computer and calibrated by Flir EX software

RESULTS

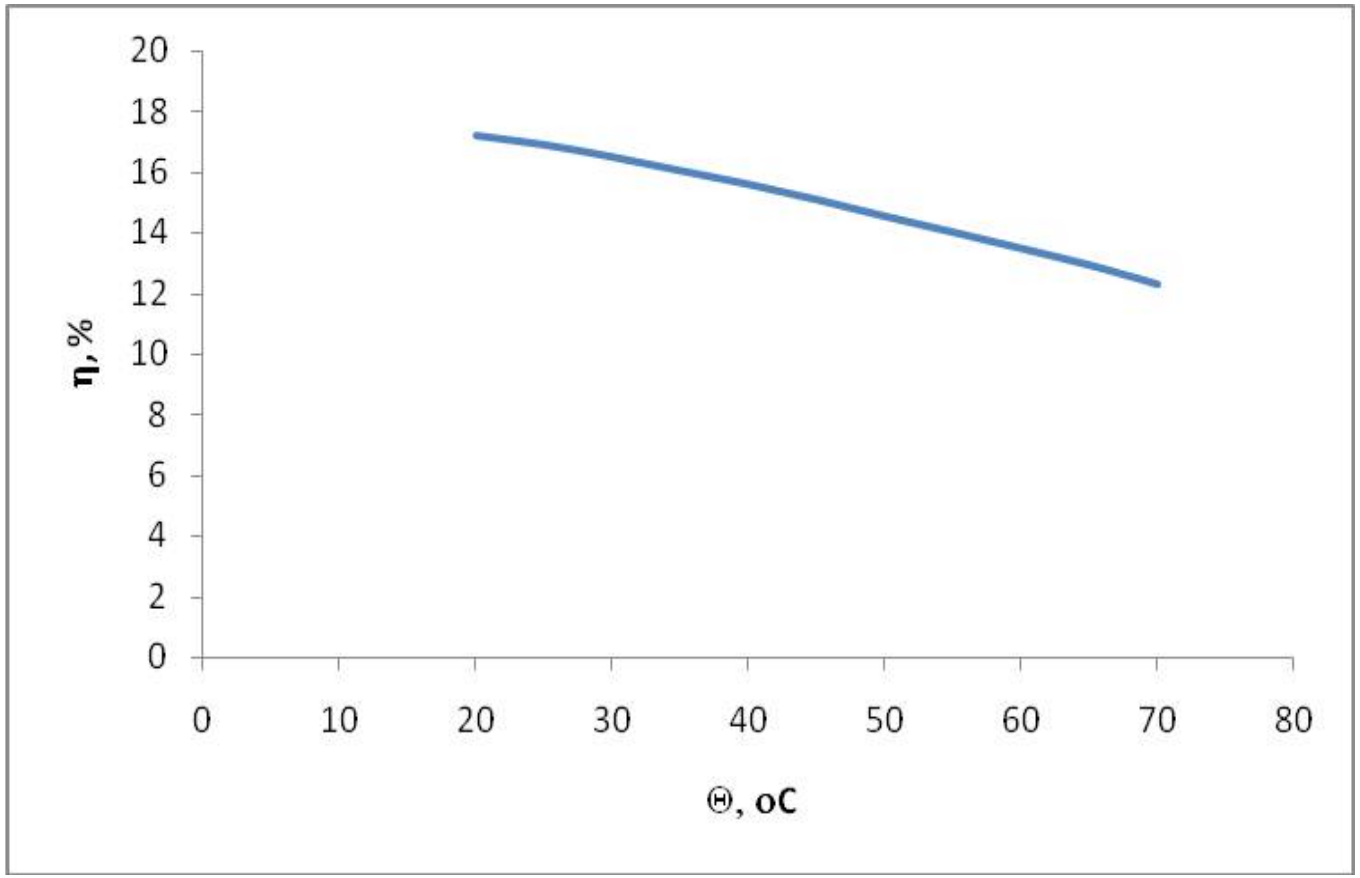
The results of the thermovision testings of monocrystalline modules 50W, 12V are presented. The module is loaded with thermal consumer of 10 Ω. At the medium sunny weather the voltage U= 14,3V and current I= 1,45A were measured. Open-circuit voltage was U_0= 20,5V.

Individual cells were illuminated with continuous non-polarized semiconductor laser with integrated collimator MGL-S-532 from “CNI” Company was used in experiments. Power in a stationary temperature regime was measured using Laser Check from "Coherent" Company and was 366 mW. The wavelength was 532 nm. Beam profile was oval with the axis ratio of 3:2, with a Gaussian distribution of power.

Thermogram of single cell at increased heating



The dependence of the efficiency of temperature



CONCLUSIONS

From energy standpoint, as well as from standpoint of reliability and maintenance it is expedient to cool the panels and to use the drained heat. The thermography was applied for the diagnosis and characterization of photovoltaic modules in order to increase energy efficiency. Results analysis of the recorded solar panels enables the detection of numerous deficiencies and potentially very dangerous spots. Results suggest actual directions for further research in terms of the system optimization.

Thank you!