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ANTI-REFLECTIVE COATING LENSES TO BOOST SOLAR ENERGY EFFICIENCY OF A III-V SEMICONDUCTOR PHOTOVOLTAIC CELL

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Introduction

In this paper, a study was made on the effects that an anti-reflecting coating ARC of a aspheric concentrator has on the solar cell. The III-V photovoltaic cell suffers a significant solar energy loss due to the radiation velocity of different mediums, i.e., air, glass and polymer. 5 to 9 per cent of the solar radiation hitting the first layer of the surface of the lens and 5 % of the second surface are reflected, and, thus, considered inefficient. Experiments at the Institute OPTICA using ARC aspheric concentrator showed a significant increase of energy output.

Purpose of the work

Applications for concentrating photovoltaic cell, low energy lost, and low reflection is desirable. The purpose of the research is to improve how the solar beam travels through the mediums of glass and plastic.

Approach

Based on the solar cell type, GaInP/GaAs/GeApplications, which was made by Spectrolab, Boeing, [1] (See Figure 1 where quantum efficiency was taken into account during coating to make the lens deposition most efficient), we choose an ARC physical vapour deposition PVD methodology for the lens-concentrator. The amount of layers as well as deposition thickness were taken into consideration.

Figures

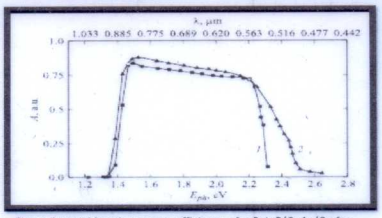

Figure 1: considered quantum efficiency of a GaInP/GaAs/Ge for efficient usage of anti reflecting coating .

Figure 2: PV Cell concentrator module using ARC lens

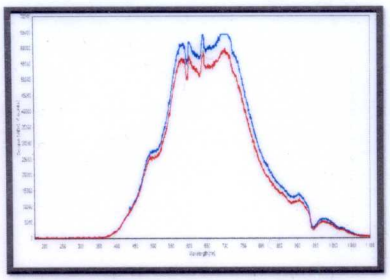

Figure 3: effects of ARC on aspheric concentrator for PV Cell

Results

ARC made on the surface of the aspheric lens was done by physical vapour deposition (PVD). Taking into consideration the broad spectrum, a combination of three layers was chosen, the order of layers are; SiO_2 - ZrO_2- SiO_2 respectively. By our calculation optimal layer thickness is; 1-SiO_2 - 85nm (n=1,47); 2 - ZrO_2- 63nm (n=1,98); 3-SiO_2 - 85nm (n=1,47); For further research development we built concentrator modules (See figure 2) where ARC aspheric lens-concentrator was used, lenses was made by PMMA[4], refractive index n-1.4941; chromatic dispersion $dn/d\lambda = -0.0575\ \mu m^{-1}$.

Conclusions

We report that research taking place at institute OPTICA was successful in terms of energy boosting for PV cell concentrator modules. Data based on spectrophotometer shows the difference before and after ARC (See figure 3). At the region of the spectrum 500-900 nm, a raise of efficiency occurs, and between 600-750nm is significant and reaches about 10 %.

References

[1] Spectrolab, by Lambert M. Surhone and Mariam T. Tennoe and Sussan F. Henssonow
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[3] Zeng, W. R.; Li, S. F.; Chow, W. K. (2002). "Preliminary Studies on Burning Behavior of Polymethylmethacrylate (PMMA)". *Journal of Fire Sciences* **20** (4): 297–317.
4 Refractiveindex.INFO - Refractive index and related constants

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5McConnell R. et al., *Qualification Standard for Photovoltaic Concentrator Modules*, Proceedings16th European Photovoltaic Solar Energy Conference, pp. 2237-2240, 2000

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