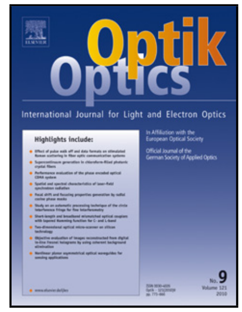
Accepted Manuscript



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PII:	S0030-4026(18)31164-1
DOI:	https://doi.org/10.1016/j.ijleo.2018.08.041
Reference:	IJLEO 61338

To appear in:

Received date:	9-6-2018
Accepted date:	14-8-2018

Please cite this article as: Juhász Junger I, Großerhode C, Storck JL, Kohn S, Grethe T, Grassmann C, Schwarz-Pfeiffer A, Grimmelsmann N, Meissner H, Blachowicz T, Ehrmann A, Influence of graphite-coating methods on the DSSC performance, *Optik* (2018), https://doi.org/10.1016/j.ijleo.2018.08.041

Influence of graphite-coating methods on the DSSC performance

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Dye-sensitized solar cells (DSSCs) can be integrated into textile materials, enabling energy harvesting with blinds, tents, or other textile buildings. The different layers of such DSSCs have to be adjusted to the requirements of the textile industry, i.e. nontoxic and low-cost materials should be used. In this work, instead of the expensive platinum, graphite is used as a catalyzer. Different finishing methods characteristic for the textile industry, such as coating with a graphite dispersion and spraying, are tested in comparison with a graphite pencil which is often used for low-cost DSSCs. Spraying is found to yield DSSCs with better electrical properties and with significantly higher longevity than graphite dispersion and is thus further optimized. By carefully tailoring the spraying time and the resulting graphite layer thickness, the power conversion efficiency could be increased by a factor of 3.

Key words: dye-sensitized solar cells, catalyzer, counter electrode, graphite, spraying

Introduction

Since the first dye-sensitized solar cells (DSSCs) were reported 1991 by Michael Grätzel [1], they have attracted great interest [2]. Many efforts are made in order to enhance their photovoltaic performances, and energy conversion efficiencies up to 14 % were achieved [3-5].

A schematic of a DSSC is shown in Figure 1. DSSCs consist of two transparent conductive oxide (TCO) coated glass plates which serve as electrodes. The working electrode is coated by a thin, mesoporous layer of a semiconductor, usually TiO_2, on whose surface a monolayer of dye molecules is adsorbed. The counter electrode is coated by a thin catalyzer layer, usually Pt. Between the two electrodes an electrolyte containing a redox couple (often I^-/I_3^-) is filled.

A photon is absorbed by the sensitizer dye, which is thereby excited. An electron from the excited state is injected into the conduction band of the semiconductor and charge separation occurs. From the semiconductor, the electron travels to the counter electrode through an external circuit, where it performs work, and is injected into the solar cell again over the counter electrode and the catalyzer