

**Research Institute:**

PTS München  
Heßstr. 134  
80797 München

**Head of the research institute:**

Dr. F. Miletzky

**Project leader:**

Dr.-Ing. Reinhard Sangl  
Tel: 089 / 12146-496  
Fax: 089 / 12146-36  
E-Mail: reinhard.sangl@ptspaper.de

Internet: [www.ptspaper.de](http://www.ptspaper.de)

**Research area: Product aims**

End products made of paper, paper board and board // Other

**Key words:**

Printed electronics, solar cells, paper-based materials

**Title: Paper-based printed organic solar cells – transformation of paper surfaces for paper-based printed solar cells****Background/Problem area**

Solar energy is supposed to contribute significantly to the energy supply in times of reduced fossil resources. Today, the majority of solar cells are based on silica. These cells, however, are rather cost-intensive and require a lot of energy for the manufacturing process. In order to accelerate energy return (which is calculated to take about 10 years), other processes and materials need to be developed.

Printing is a cost-effective manufacturing process and paper is a substrate with a number of advantages as compared to plastic foils: cost-effectiveness (1 € per t versus 7 € per t), printability and dimensional stability in temperature ranges of interest, and recyclability.

The layered structure of a conventional solar cell has to be inverted if a paper (of little opacity) serves as a substrate.

**Objectives/Research results**

Investigations on substrate development and tests for a cathode coated on this substrate are the contributions of PTS as a research partner. Additionally, the organic structures of the solar cells need to be encapsulated in order to prevent water vapour and oxygen from reacting with the organic layers.

In order to meet the requirements for solar cells, a substrate has to be developed where a surface morphology is avoided with peaks that would pierce following layers and lead to short cuts destroying the functionality of the system. Using a pigment free coating on top of a levelling precoat was by now the most effective way to come close to the required smoothness.

For encapsulation, barrier coatings were applied. Further tests need to show the effectiveness of these barriers, as the exact demands from the organic layers are not known in detail.

For applying a conductive layer to serve as a cathode of the solar cell using coating technologies, silver pastes appear to offer feasible solutions. For conventional coating trials in semi-industrial scale – as planned in the technical equipment of the research institute, the losses will not be negligible and only a small number of tests is planned towards the end of the project.

It is not expected that the new solar cells are going to be as effective as conventional silica-based solar cells, and also life time will be lower for the newly developed materials, but due to lower energy demands for the manufacturing process and less expensive materials used, a higher energy efficiency is expected.

PTS task is to develop a substrate for printed solar cells with high smoothness and good printability

BU Wuppertal shows responsibility for the development of semi conductors and the improvement of semi conductors concerning solubility and morphology.

TU Chemnitz conducts printing trials in order to investigate and improve the interdependencies between material and process parameters.

Würzburg University is going to characterize the printed solar cells, investigate stability and perform simulation studies with the aim to optimize the printed solar cells.

**Application/Economic benefits**

Especially the low manufacturing costs will allow for many new fields of application of solar cells like on displays, packages or even newspapers.

Printing solar cells allows for cost effective use of regenerative energy sources and comparatively short times to re-gain the energy necessary for the cell manufacturing. The low manufacturing costs for papermaking and printing can open up a new markets for inexpensive solar cells with a short life time, which is not available for the more effective but also more expensive silica based solar cells. International competitiveness on a seminal market is to be strengthened when low cost solar cells are included in the fields of competences of German enterprises.

**Project period: 01.07.2008 – 30.06.2011**

**Remarks**

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