KÖMMERLING

KÖMMERLING CHEMISCHE FABRIK GMBH

PRESSEINFORMATION
PRESS RELEASE

GPD 2009 in Tampere, Finnland

Ernst Semar: „Kleb- und Dichtstoffe für die Photovoltaik-Industrie“

Als führender Hersteller von Kleb- und Dichtstoffen sowohl für die Bereiche Glas, Transportation und Industrie, als auch für Photovoltaik und Solarthermie, ist eine Beteiligung an den *Glass Performance Days* in Tampere für KÖMMERLING unerlässlich.

Vom 12. bis 15. Juni 2009 trafen sich Entscheidungsträger, Experten und Architekten aus mehr als 50 Ländern, um über die neuesten Entwicklungen in der Glasindustrie zu berichten.

Ernst Semar, Leiter Produktmanagement bei KÖMMERLING CHEMISCHE FABRIK GMBH, informiert mit seinem Vortrag über die Anforderungen an Kleb- und Dichtstoffe bei der Abdichtung von sowohl kristallinen als auch von Dünnschicht-PV-Modulen. Seine Präsentation stellt Lösungen zur Randabdichtung von Dünnschichtmodulen vor. Des Weiteren eine laminatfreie Modulvariante, die in der Branche unter dem Fachbegriff „Multi-Layer“ bekannt ist.

Im Bereich Gebäude-Integrierte Photovoltaik (**B**uilding **I**ntegrated **P**hoto**V**oltaics) referiert Ernst Semar über die Möglichkeiten, PV Module mit der bewährten Isolierglas-Technologie zu kombinieren.

Postfach 2162
D – 66929 Pirmasens
Tel.: +49 6331 56-1100
Fax: +49 6331 56-1110
www.koe-chemie.de
e-Mail:
marketing@koe-chemie.de

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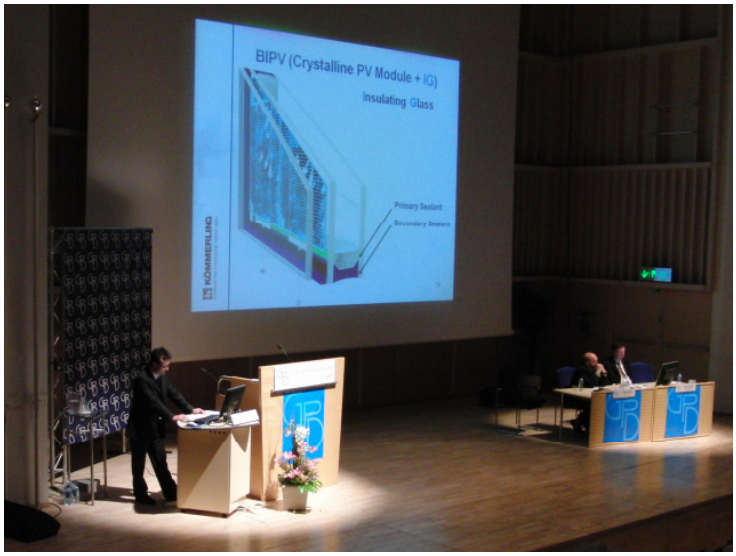

Ernst Semar, KÖMMERLING CHEMISCHE FABRIK GMBH:
„Kleb- und Dichtstoffe für die Photovoltaik-Industrie“

Auf den folgenden Seiten finden Sie den Abstract zum Vortrag von Ernst Semar „Kleb- und Dichtstoffe für die Photovoltaik-Industrie“ auf den diesjährigen *Glass Performance Days* in Tampere.

Postfach 2162
D – 66929 Pirmasens
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Fax: +49 6331 56-1110
www.koe-chemie.de
e-Mail:
marketing@koe-chemie.de

Sealants and Adhesives for Photovoltaic

Ernst Semar Kömmerling Chemische Fabrik GmbH semar@koe-chemie.de
Dr. Harald Becker Kömmerling Chemische Fabrik GmbH becker@koe-chemie.de
Dr. Wolfgang Wittwer Kömmerling Chemische Fabrik GmbH wittwer@koe-chemie.de

Keywords

1 = Photovoltaic 2 = Sealants 3 = Adhesives 4 = BIPV 5 = Moisture 6 = Compatibility 7 = Corrosion

Abstract

This paper provides an outline of the requirements for sealants and adhesives which are used for the assembly of PV modules based on various designs including lamination or multilayer technology. Also convincing solutions for the growing interest to seal PV modules (especially TF, **T**hin **F**ilm modules) against moisture ingress are presented.

In the field of BIPV (Building Integrated Photovoltaics) the paper discusses the option to combine PV modules with insulating glass technology - in particular an easy way to pass the electrical ribbons via the edge of modules and the compatibility of the used components.

Introduction

Especially the long term stability (efficiency rate) of TF modules depends on the tightness against moisture. These TF modules can be built up in substrate - or superstrate configuration depending on the type of semiconductor.

Substrate configuration

- CIGS solar cells

Superstrate configuration

- CdTe solar cells
- a-Si solar cells
- a-Si/µc-Si solar cells

The parts in focus are the TCO (**T**ransparent **C**onducting **O**xide) and the semiconductor itself each of which is more or less sensitive to moisture. Therefore one key feature for every PV module is water vapour impermeability which should provide more than 20 years of durability. A second other key feature is the respective compatibility of all the used materials.

A typical design of a TF module

A superstrate configuration comprises of a front glass sheet with the TCO and the semiconductor combined with a back sheet which could be a second glass sheet or a plastic film. The front glass and the back sheet are bonded with a lamination film. The films used are usually not tight enough to prevent moisture vapour penetration.

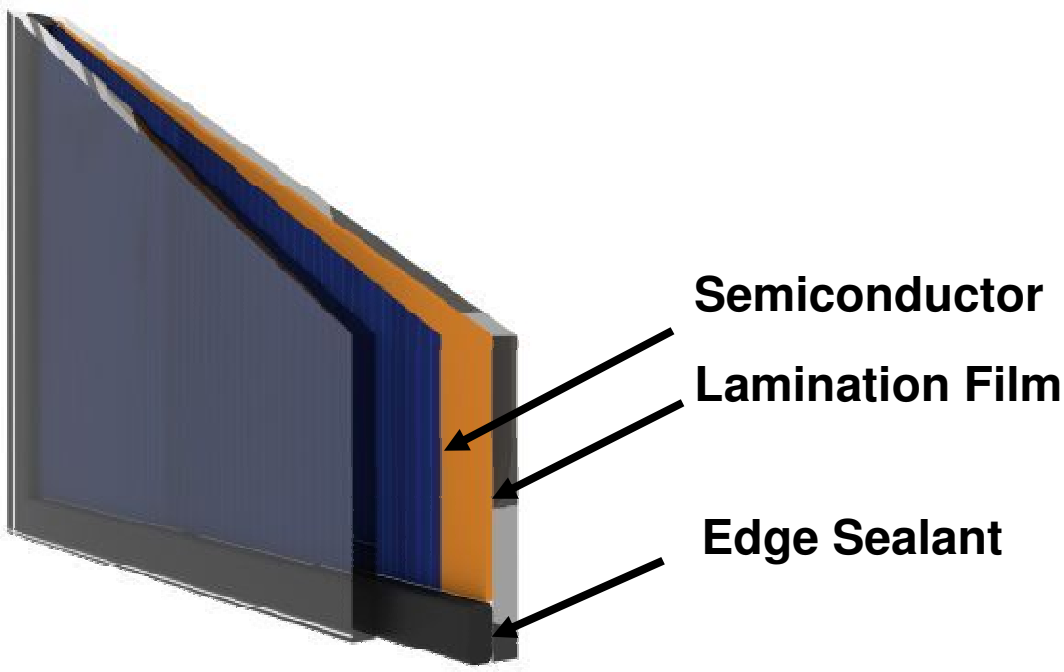

Figure 1:
Typical design of a TF module + moisture protection

How can we realize a good moisture barrier?

The moisture vapour ingress of a sealed system depends on the properties of the sealant (bulk) itself and the tightness of the boundary layer between the sealant (bulk) and the substrate.

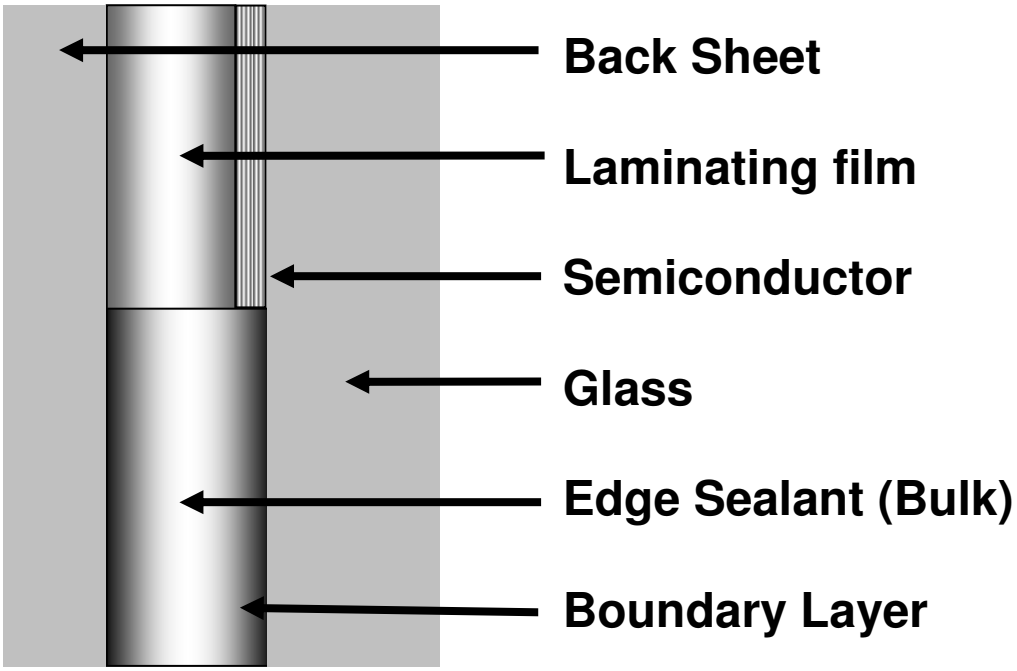

Figure 2:
Edge area of a TF module

If we look to the bulk we have to differentiate between water tightness and moisture vapour tightness. These are two completely different properties. Everybody knows that a silicone is tight to water but how does it respond to moisture vapour? The MVTR (Moisture Vapour Transmission Rate) of silicone is approx. 20 g/(m²d) measured according the EN 1279 part 4 – this is a very high figure for elastic or plastic materials. The typically used lamination films are better but not good enough to protect the semiconductor and the TCO. The sealants with the best MVTR are PIB (**P**oly**i**so**b**utylene) based materials, which provide less than 0.01 g/(m²d) moisture penetration rate. That means there is a factor of 2000 between silicone and PIB. With special formulations the ratio can be additionally improved. But as mentioned it is also necessary to close the boundary layer in order to get a real moisture vapour barrier. To achieve this the surface must be absolutely clean in particular after the edge deletion (sandblasted or with laser) of the glass sheets. The proper wet out and the adhesion of the sealant has to be tested before starting the mass production.

Another point is the correct application of the sealant. The process parameters should be defined together with the sealant supplier and must fit to the individual design of the solar panel.

With PIB based sealants we have had excellent results after damp heat - and temperature cycling test. Minimum 2 runs are possible and the testing is still ongoing. PIB based sealants are available in tape form or in drums for hot melt application. The hot melt application in combination with the proper dosing system offers a perfect wet out on the surface and narrow tolerances.

Compatibility of different materials

A further important issue is the compatibility of the different materials being used. In the case for a typical solar panel this is the compatibility between lamination film, edge sealant, semiconductor and framing materials. None of the components involved should be affected by any of the other components in a way that detracts from its function in the system and the system should not be affected by interactions of any of its components. Impact on the properties of either components or the system are a result of migration of ingredients of one component to another.

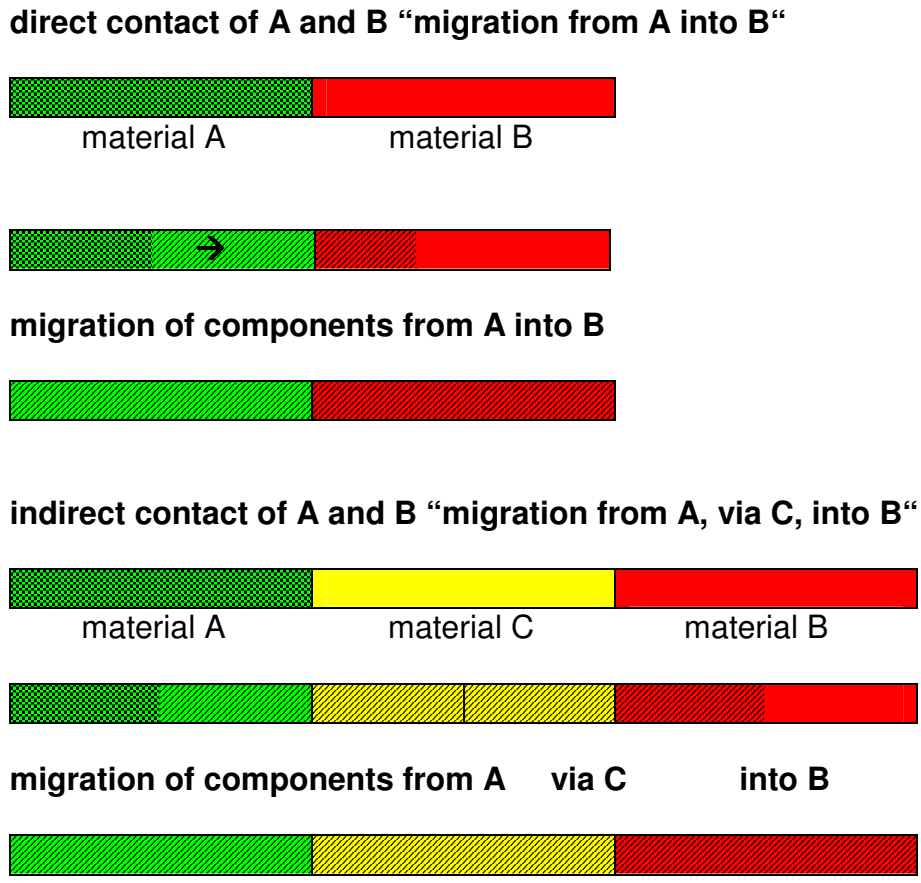

Figure 3: Migration process

As shown in figure 3 there is not only a migration from A to B possible but also from A via C to B. That means it is also necessary to investigate the indirect contact of materials. It is also strongly recommended to review your design with respect to compatibility. If there is no clear answer compatibility testing is absolutely necessary.

The sealing of the drilling holes for the electrical ribbons through the backside of the PV module has to be considered under the same criteria of moisture vapour barrier and compatibility. For this application we have also had good experiences with PIB based sealants.

Special requirements for BIPV

In the field of BIPV there are some more points to be considered as in standard PV applications. One option of BIPV is to combine a PV element with an insulating glass. In this case it is necessary to connect the ribbons via the edge sealant of the module. Multi-layer technology offers new possibilities to the PV industry for the module design (crystalline as well as thin film). Multi-layer means to extrude a first bead of PIB, positioning of the ribbons and then the application of a second bead of PIB. The PIB provides the tightness to moisture vapour and the silicone ensures the mechanical stability. This technology is a smart solution to feed the ribbons through the edge of the module – perfect for BIPV.

In figure 4 a multi layer module is shown without a lamination film. Therefore we need a structural silicone for bonding the two glass sheets together. This technology has the big advantage that there is nearly no limitation in the size of the PV element and you can produce the PV module integrated into an insulating glass unit on the same production line.

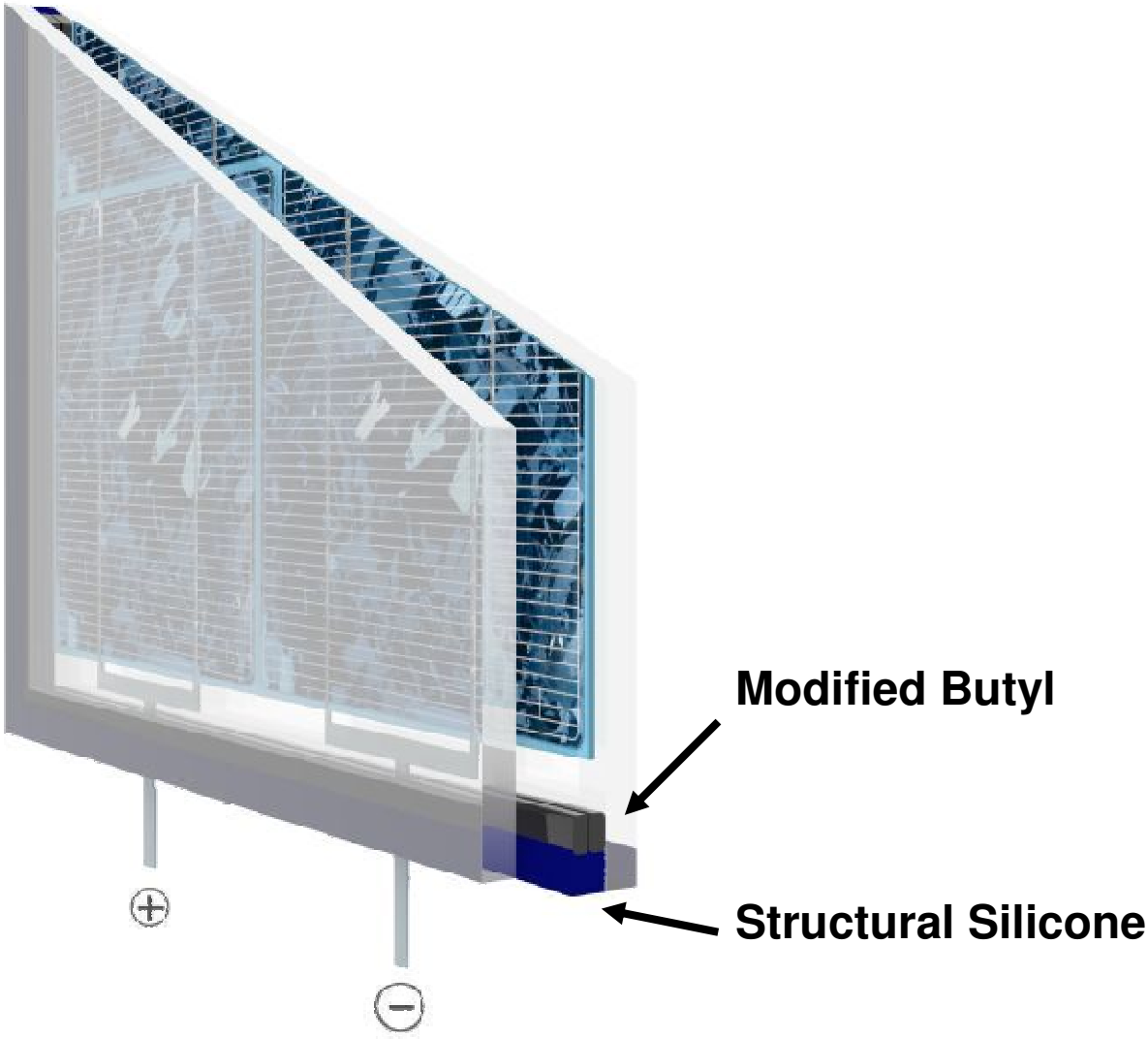

Figure 4:
Multi-layer technology in combination with crystalline cells

Compatibility is a key issue when insulating glass is used as one of the combination elements. In this case there are several materials from the PV module and the insulating glass unit in combination. In parallel the performance of the insulation and the efficiency ratio have to be insured for long time. The sealants and adhesives used must maintain their function for long periods of time under the influence of heat, UV, humidity, oxygen and aggressive trace gases in the air.

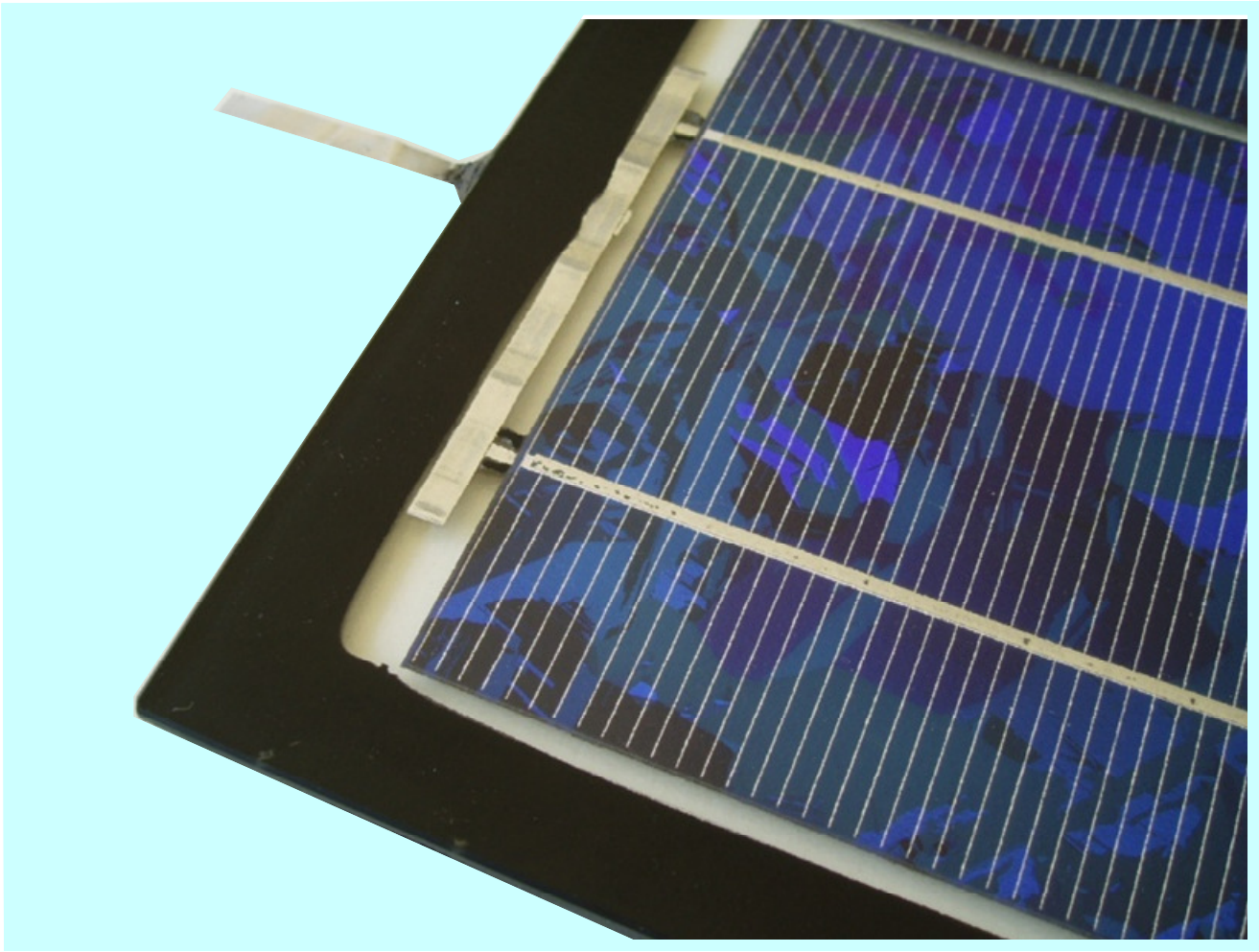

Figure 5:
Multi-layer technology PV module from Apollon Solar

Conclusions

A wide range of technologies in the field of functional organic materials for bonding, sealing and insulation are necessary to fulfil the specific needs of the PV industry. These technologies are the key to the successful design, production and marketing of solar panels. The different systems should be compatible to each other with regard to processing and product design.

In the area of panel sealing, the focus is on the protection of components against ageing and functional losses due to environmental factors. Sealing technology specially designed for solar panels will largely prevent the ingress of liquids and suspended particles and will also reduce the diffusion of gaseous elements of the air like water vapour, oxygen, nitrogen and sulphur oxides.
To achieve this, the permeability of the materials has to be as low as possible but also wetting on the surfaces of the contact materials has to be efficient, in order to prevent diffusion along the interfaces.

Liquid application of the systems allows perfect degrees of freedom in design and assures robustness of the application and function.

With regard to any temperature stresses that may occur, the technologies must allow for the compensation of the different thermal extensions of the materials, thereby avoiding tension peaks.

Sealants must maintain their function over very long periods of time under the influence of heat, UV, humidity, oxygen and aggressive gases in the air and in contact with other materials. To ensure their long service, accurate analysis, intensive systematic investigation and years of experience is required from the sealant and adhesive supplier.