The “eternal bonding agent” is not yet required, but because a solar cell has an extremely long life, the glue must hold just as long, if possible – for twenty or thirty years, and in the future possibly for as long as forty years. The same applies to films. The chemical industry has been prepared for this for a long time, actually quite effortlessly, because they are used to dealing with demanding customers – the automobile industry, for example. The demands of the PV industry for quality and durability are at least as high.

Glass lasts practically forever, so one does not need to worry about the front panel of a module. The back panel is covered with a film which must fulfil various requirements. The back panel film is a razor-thin laminate. The US manufacturer Madico produces Protekt backsheets, which consist of four layers. Beneath a 10 µm thick polyfluoride protective layer, there is a polyester layer (125 µm) and an EVA layer (110 µm); and between both there is an adhesive layer.

The Akasol film, manufactured by Krempel, consists of five layers. The polyester core layer, which is embedded in two adhesive layers, can vary from 50 to 330 µm in thickness, depending on the requirements. However, the system voltage to which the module is exposed is decisive (up to 1,000 V). To protect the core layer from UV radiation, both of the outer layers usually consist of polyfluoride. The plastics of this group are characterised by a high chemical resistance (the most well-known example is Teflon) and absorb UV radiation, which makes them suitable as protective layers for back panel films. On the front side, polyfluoride films are used instead of glass when the modules need to be flexible, for example to install them on curved roof surfaces.

But polyfluorides can only be manufactured under high safety measures due to the aggressiveness of hydrofluoric acid. For this reason polyamides are increasingly used as a protective layer, which is wear and tear resistant (the most well-known example is nylon), and in addition have the advantage that they can be manufactured from renewable resources. This material, which is only comprised of the four elements carbon, hydrogen, oxygen and nitrogen, is more in keeping with the environmental friendliness and sustainability of solar power generation than polyfluoride. For this reason, Evonik has recently been offering the polyamide laminate Flexoskin, which offers even better UV protection and is supposed to be more scratch-resistant than polyfluoride laminate as well.

However, the back panel films can do even more, as for example Krempel proves with custom-built products. The company offers back panel films with a copper layer (metal laminate) for the production of back panel contact cells, as well as laminates with aluminium foil and correspondingly low vapour permeability for sensitive cell technologies.

Physics makes sure that electricity flows, but without chemistry it would be a short-lived pleasure. Films protect the solar cells from UV light and moisture for decades; glues permanently hold the module together. The silent helpers in photovoltaics can do even more, as the EU PVSEC showed.

Fast manufacturing requires fast adhesive bonding. For this reason, gluing is especially suitable for module production, but the adhesive bond must last for at least 20 years in all weather conditions. Loosened screws can be tightened, but loose adhesive bonds cannot be fixed, they must be renewed. By now, the durability of adhesive bonding is beyond question, and for this reason it is gaining importance in the PV industry as well. Frame and box adhesive bonding have proven effective over the long term; cell and cable fixation were subsequently added.

At the beginning of the year Tesa introduced a new generation of high-strength technical adhesive tapes. The double-sided acrylate adhesive tapes are based on environmentally sound technology and are especially durable. Tesa describes the process as ACX technology – derived from the term “Acrylate Extrusion” –
and manufactures especially thick layers with extremely strong adhesion. Because of the thickness, the adhesive agent can counterbalance vibrations and tensions which occur between the two bonded parts. This is especially advantageous for severe temperature fluctuations and different expansion coefficients of the glued parts.

Adhesive bonding can also simplify the installation of thin layer modules, which are mostly manufactured as glass-glass modules. These modules are usually attached to the underframe with brackets. The tension in the glass is highest under the four brackets which hold the module. As an alternative, two corrugated profiles can be affixed to the rear glass pane with an adhesive agent. The pressure is more evenly distributed as a result and stress peaks no longer occur.

Sika offers two-component adhesives on a silicon basis, which are suitable for use in the PV industry. Two-component adhesives bind more quickly, and they have a further important advantage: The hardening can be controlled regardless of humidity. For example, the adhesive Sikasil AS-780 offers a much higher early strength build-up than the usual fast-binding two-component adhesive based on silicon. The early strength build-up is necessary for example, so that the back rails (fixation rails) do not slip after gluing.

### Plastic instead of aluminium

Plastics can generally contribute to the direct improvement of the PV module and indirectly also to a rise in the energy yielded, just by prolonging the operating life. Furthermore, plastics can contribute to cutting costs which is the cardinal rule for the PV industry at the moment. Considering the highly fluctuating, steadily rising prices for raw material, it is sensible to replace aluminium with plastic as much as possible, for example.

For years BASF has been manufacturing a polyamide called Ultramid for the construction industry, and so it makes sense to manufacture fasteners for PV modules from this material as well. At the PVSEC, BASF showed an outdoor assembly system whose joints are made of Ultramid instead of aluminium. The fixation clips for trapezoidal sheet metal roofs are a further example. They are pre-installed on the roof so that the rails for module fastening can be easily pushed into the mounting bracket. The tension caused by temperature fluctuations between the aluminium rails and the steel roof are absorbed by the plastic, which is characterised by a high strength and rigidity. Further applications are being developed.

*Detlef Koenemann*