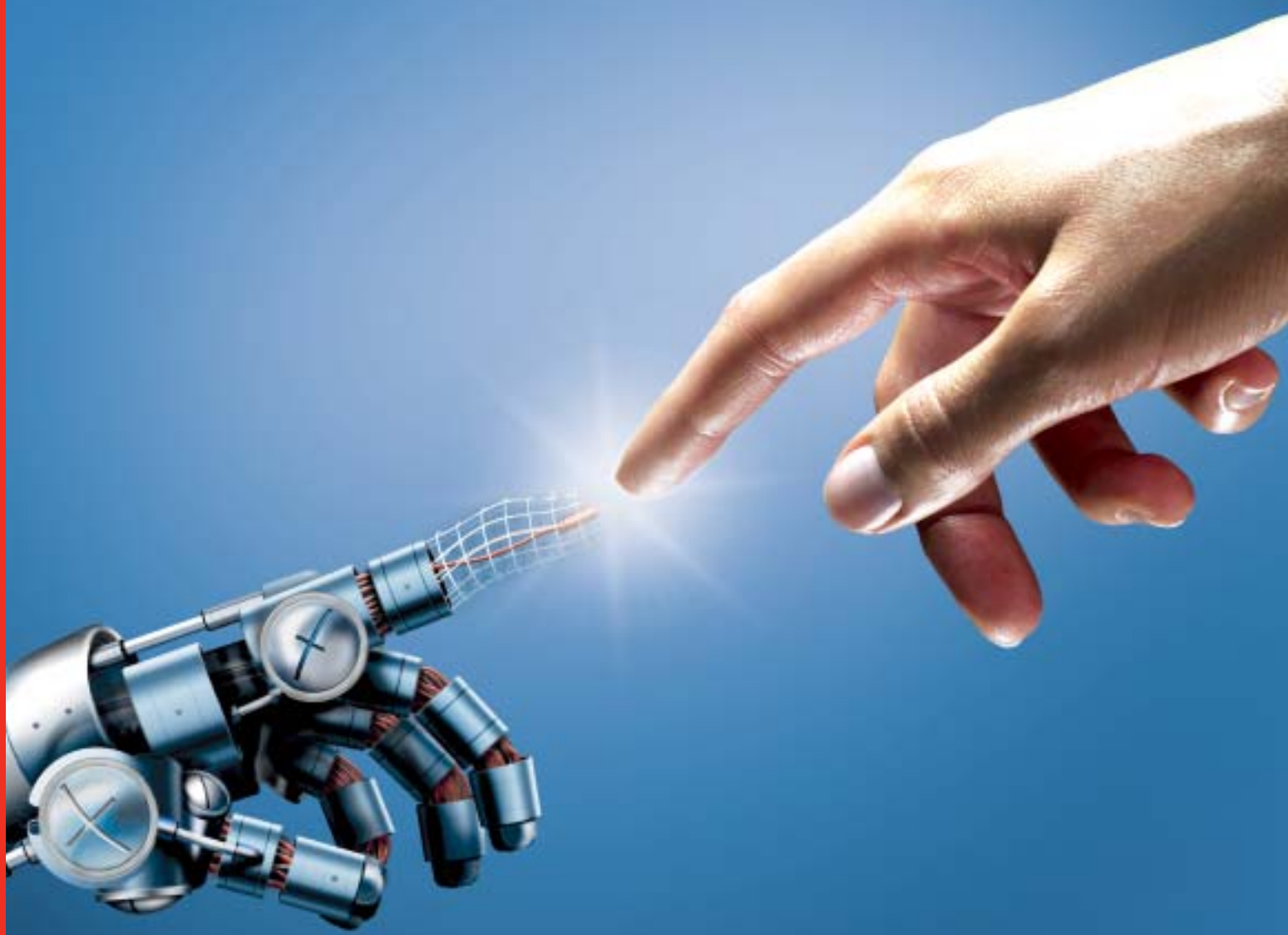
in view of tomorrow 2005

Research and Development at Henkel



Henkel

A Brand like a Friend

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Solar roof off the roll

"It never rains in California" – and this is where the idea of integrating flexible solar cells into polymer roofing membranes originated.

Product developers for industrial adhesives (l. to r.):
Dr Reimar Heucher, Kornelia Theissen, Dr. Siegfried Kopannia

Electricity from the sun will be a key source of energy in the future. Engineers in the USA have come up with the idea of integrating flexible solar cells into roofing membranes. SmartRoof! can be installed easily on flat roofs. Henkel, as a system provider, is playing a major role in this innovative technology, by providing tailor-made high-tech adhesives.

With its many hours of sunshine, California has a tremendous advantage, as it can harness the sun's energy on a large scale for the eco-friendly generation of electricity. The first solar roofing systems made of flexible large-area membranes are now in use in Torrance, California. At the heart of these systems are dark-blue, shimmering, thin-film solar cells. They consist of amorphous silicon, which is applied to a fine polymer film by means of a vacuum process. Twelve of these solar modules are laminated to a twelve-meter long and three-meter wide weatherproof polymer membrane to form a solar panel. The panel can simply be laid directly off the roll and connected to any number of other panels. In Germany, for example, each panel can supply up to 1200 kilowatt hours of electricity per year, which corresponds to the average power consumption of a one-person household.

The first roof systems installed by Solar Integrated Technologies (SIT) of Los Angeles, the company that conceived the SmartRoof! idea and now markets the system worldwide, proved a great success. SmartRoof! is the first solar system that is suitable for production on an industrial scale. "It will revolutionize building services design and provide a major boost to renewable sources of energy," predicts Edward J. Stevenson, a founding member and CEO of SIT. He then adds: "The successful launch is due in no small measure to the commitment of our partners, Henkel, Coatema, Sarnafil and Uni-Solar. As well as supplying the various components, they also contributed their specific know-how to this development."

Development of adhesives played a crucial role

A team from Henkel Technologies, composed of adhesives experts from Germany and the USA, shared the enthusiasm for the project. The development of suitable adhesives was a tough challenge, on

The bigger the roof, the more power is generated

One of the first users of the SmartRoof! system is Frito-Lay, a manufacturer of snacks. Frito-Lay is a member of the PepsiCo Group, and its distribution center in Torrance, California, has a 6,000 square meter flat roof.

The solar modules of the installed system cover about 45 percent of the roof area. A solar module with an area of 2.4 square meters can produce 1.5 kilowatts of electric power per hour. Since energy from public utility sources in California is scarce and expensive during the hours of peak demand, the SmartRoof! system saves Frito-Lay quite a bit of money in the course of a year.

The investment costs are low in comparison to those of conventional photovoltaic systems. In view of its cost effectiveness and the fact that it can be installed quickly and easily, demand for the SmartRoof! system is rapidly growing. Encouraged by the success of the first project, Frito-Lay has already installed SmartRoof! systems on a number of other buildings. Frito-Lay now draws about one million kilowatt hours of electricity from SmartRoof! solar cells.

Henkel's partners at Solar Integrated Technologies (l. to r.)
Edward J. Stevenson, Bruce M. Khouri, Kevin Tabor

Photovoltaic

The word photovoltaic is a compound of the Greek word for light and the name of the physicist Alessandro Volta. It describes the direct conversion of sunlight into electrical energy by means of solar cells.

which the success of the whole project depended. Although the adhesives account for only a small part of the total volume of the SmartRoof!, the quality of the bonding is ultimately crucial, if the system is to function properly.

In all, three bonding problems had to be solved before the SmartRoof! could be produced:

- laminating the solar modules flat to the solar membranes,
- sealing all of the edges of the solar modules to protect them against moisture, and
- encapsulating the electrical wiring on the back of the membrane.

Two different kinds of Henkel adhesives are used: polyurethane-based Purmelt hotmelts and polyamide-based Macromelt hotmelts. The formulations were chemically modified for this specific application. “The multiple requirements made on the adhesives are very challenging,” explains Dr. Yingjie Li, the project team member from Elgin, Illinois, near Chicago, who is responsible for the polyurethane hotmelts. “They must bond the different components absolutely reliably; they must satisfy the technical requirements of the production process used to make the system; and they must, above all, be able to durably withstand the stresses of weather conditions and fluctuations in temperature to which the roof is exposed.” As Dr. Dwight Heinrich, the Elgin staff member in charge of developing the polyamide hotmelts, adds: “A particularly challenging requirement was the need for the adhesives to remain stable under ultraviolet radiation.”

A real challenge for Henkel’s developers: Among other requirements, the adhesives have to remain stable under ultraviolet radiation.

Three time zones, two continents, one team

Throughout the development process, an intensive dialogue had to be maintained with the customer. The development was an exceptional challenge not only from a chemical and engineering point of view, but also organizationally. "We had to be on site in Los Angeles to ensure that we always knew precisely how the project was progressing. At the same time, we had to coordinate the work of our specialists at three different locations," explains project manager Kornelia Theissen.

The development work on the adhesives was carried out in Düsseldorf and Elgin, while the application tests and the tests needed for official registration in the USA were prepared in the Henkel Technology Center in Heidelberg. The necessary certification of the solar modules in the USA was obtained from Underwriters Laboratories (UL), a nationally recognized testing laboratory.

At the same time, the formulation was transferred from Germany to the USA to allow production to be carried out locally. As Theissen puts it, "Three time zones, two continents, one team. We all worked together fantastically – which made it all the more satisfying."

Accelerating trend toward renewable energies

SIT is now listed on the stock exchange and is vigorously targeting international markets to expand its business in photovoltaic roofs. The system doesn't need bright Californian sunshine to be effective; it also functions in more moderate daylight. Germany, a country where there is a high level of environmental awareness, is a major marketing objective. There is no shortage of suitable industrial and public buildings.

As a system partner of SIT, Henkel's development team still has plenty of work, and market opportunities, ahead of it. Global economic conditions are accelerating the trend toward renewable forms of energy. Henkel is now able to serve the entire value chain in photovoltaics – from cleaners for the production of semiconductor wafers to the adhesives and sealants needed to make the solar modules themselves.

Solar cells

Solar cells can be crystalline or amorphous. If they are crystalline, they have a regular crystal structure, which can have an ideal arrangement of atoms or might include impurities. They are accordingly referred to as monocrystalline or polycrystalline. Monocrystalline cells are difficult to produce, while polycrystalline cells are simpler and require less outlay. Crystalline cells are mainly used for medium-sized and large professional solar power systems.

Amorphous cells have no regular crystal structure. They consist of a thin layer of amorphous silicon, which is sprayed onto a substrate such as plastic. Only very thin layers are needed to achieve the photovoltaic effect, hence the name "thin film cells."

The efficiency of amorphous cells is lower than that of crystalline cells. On the other hand, amorphous cells generate an electrical current even in diffuse light. Amorphous cells are also lighter, cheaper, and less energy-intensive to produce.

Product developers from Elgin near Chicago, Illinois: Dr. Dwight Heinrich (l.) and Dr. Yingjie Li

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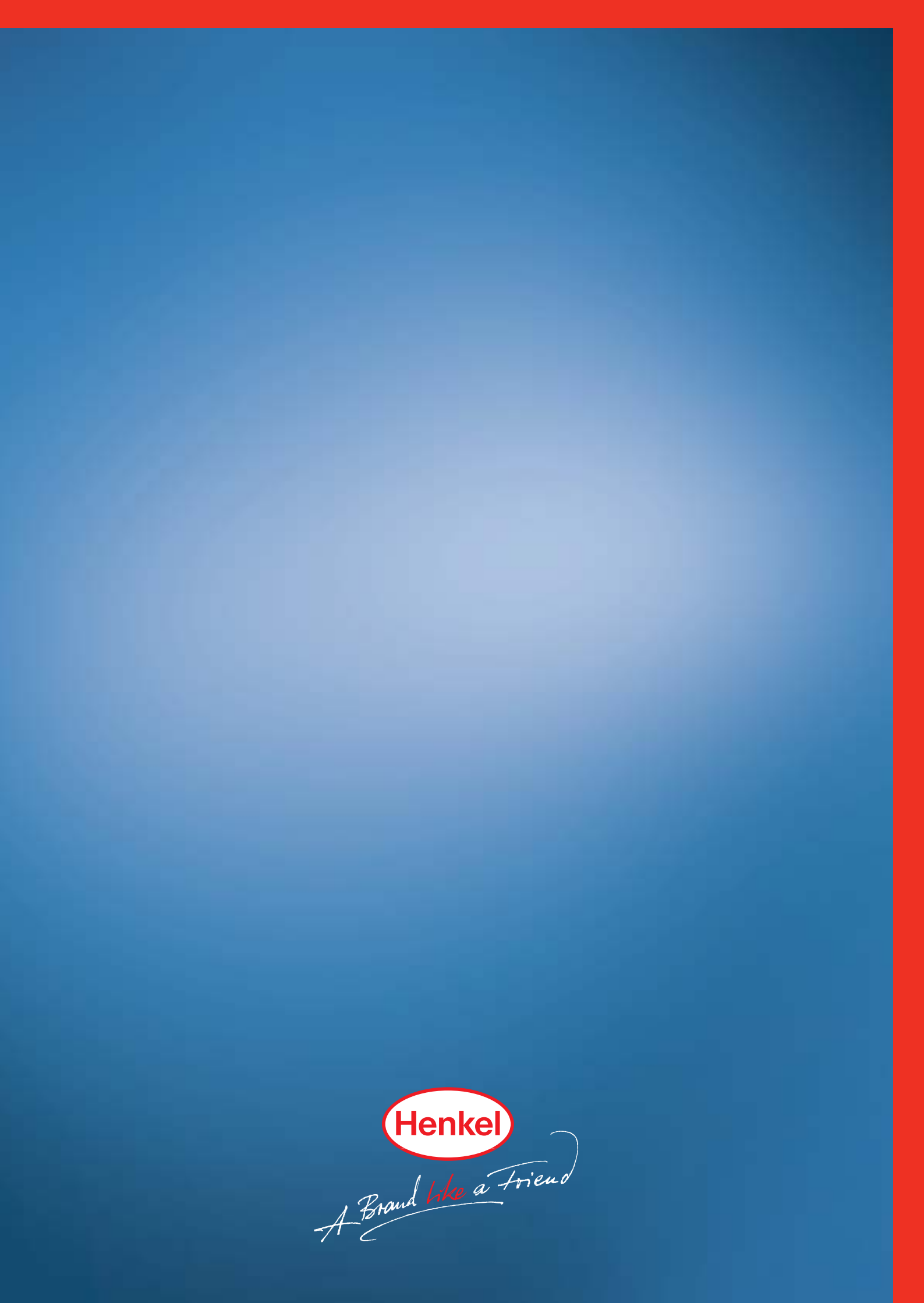
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