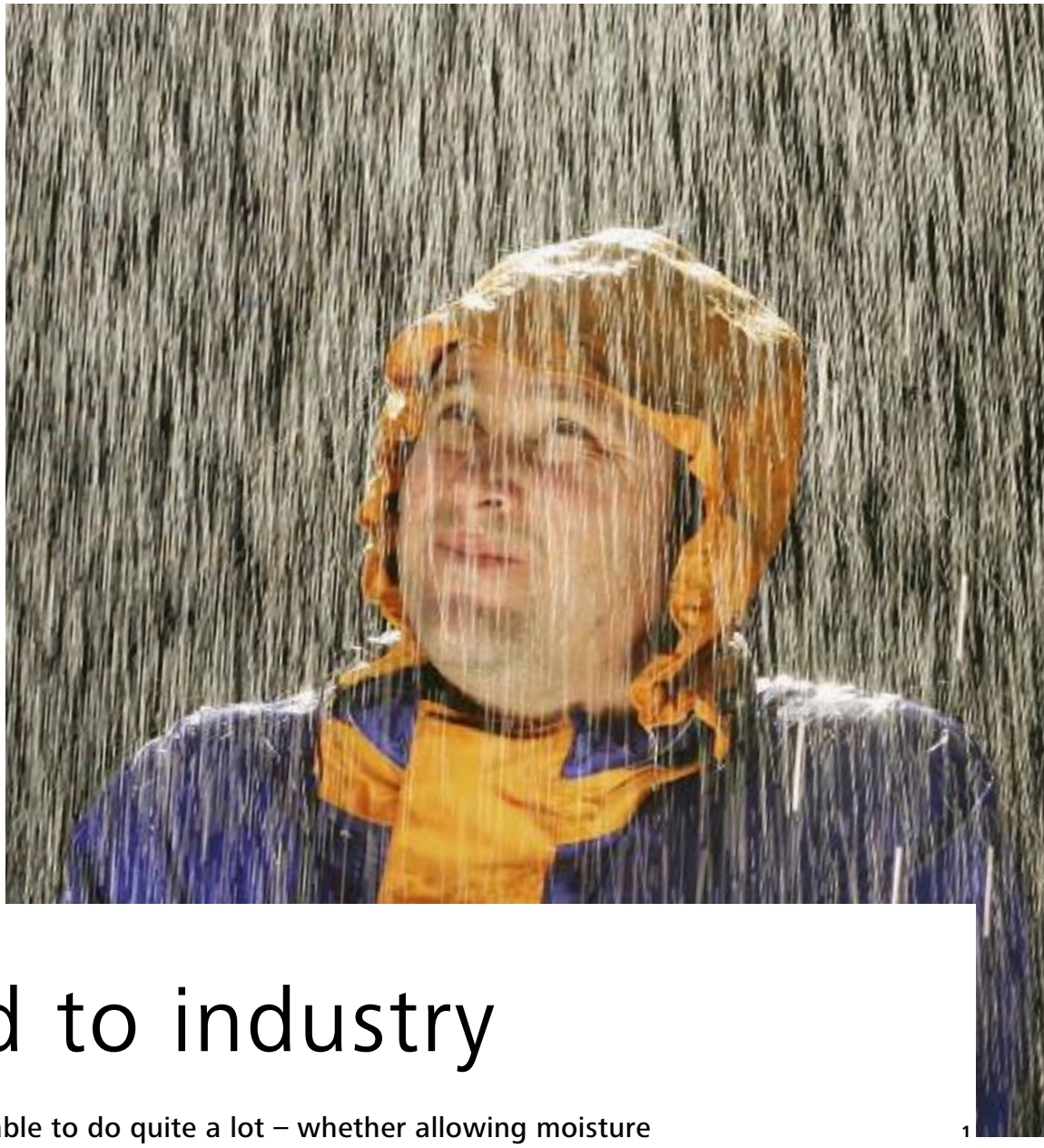

1

Adapted to industry

Clothing today must be able to do quite a lot – whether allowing moisture to wick away for improved comfort when worn or, in contrast, being watertight to protect against rain. In order to equip textiles with the desired properties, industry is always looking into new processes, one being plasma technology. Together with industry partners, Empa has made this technology industrially viable for the textile sector. The first products are already in development.

TEXT: Beatrice Huber

2

3

Textiles made of synthetic materials have the disadvantage that they generally are only partially wettable and thus still must be finished. Depending on the desired end use, the issue becomes one of making the textiles either more water permeable (more hydrophilic) or more water repellent (more hydrophobic). A hydrophilic treatment improves a textile's comfort when worn because perspiration can more easily make its way through clothing. If textiles are printed, they must be given this treatment ahead of time, otherwise the print doesn't adhere. Clothing intended to protect against water, such as rain, is given a hydrophobic treatment.

For decades, the textile industry has been looking for improved processes to make fabric either more hydrophilic or more hydrophobic. That's because the wet-chemical methods still common today are deficient in areas such as being resistant to wash and wear. In addition, they change the textile's properties, in particular its feel. Last but not least, they also consume large amounts of energy and water.

Plasma: moving from microelectronics to textiles

An alternative can be found in plasma technology which, for instance, has been long used in microelectronics for coating wafers. The key advantage is that it's dry and environmentally friendly. Low-pressure plasma processes have until now been considered too expensive for textiles, but this could soon change. Empa's Advanced Fibers Laboratory has been researching this technology for some time and is operating a pilot plant. Further, the lab has been collaborating with six textile companies as well as the Nano-Cluster Bodensee (NCB, see box), in a project financed by the Swiss Innovation Promotion Agency CTI to clarify more precisely the suitability and economic efficiency of plasma technology for the textile branch. "There's long been an interest in plasma technology in this branch. For instance, it was discussed intensively in a focus group at the Nano-Cluster Bodensee. Our project is a result of those discussions," reveals Sébastien Guimond, head of the project at Empa.

For plasma technology, gases serve as the raw materials. They are first activated to a plasma state in a vacuum chamber through the application of voltage. The activated molecules then collect on a substrate – such as a textile – in a thin layer consisting of only a few nanometres. This has the advantage that the properties of the textile, such as its feel, are not impaired.

1
Textiles should fulfil a wide range of tasks; one of these is protection against moisture. (Photo: iStock)

2
As a rule, synthetic textiles are only partially wettable, as shown here in the middle. Thus they must either be frequently given a hydrophilic (left) or a hydrophobic treatment (right). (Photo: Empa)

3
Together with six textile companies as well as the Nano-Cluster Bodensee, Empa's Advanced Fibers Laboratory has made plasma technology viable for industrial applications in the textile branch. Empa's pilot plant represents a decisive factor for the transfer of process knowledge from the laboratory to industrial scale. (Photo: Empa)

Multiple steps covered in the value-added chain

Together, the project partners cover multiple steps in the textile value-added chain. Empa's pilot plant is almost a perfect complement to the industrial plasma plant of the Austrian textile-finishing company Grabher Günter Textilveredelungs GmbH, which uses it to provide finished products for the participating Swiss firms (Christian Eschler AG, AG Cilander, Sefar AG, Bezema AG and Bischoff Textil AG). The NCB took over management of the project and worked out a cost model.

The established goals were all attained and the project was a complete success. All the plasma coatings newly developed by the Empa team, which includes Sébastien Guimond, Barbara Hanselmann and Dirk Hegemann, led to the textiles undergoing a hydrophilic treatment having a considerably longer lifetime and being more washable compared to results from existing methods as proven in laboratory lifetime tests. Two coating processes have already been successfully transferred from Empa's pilot plant to Grabher's industrial scale plant, and a further coating has been optimised there.

Robust processes developed for industry

Processes which are to stand the test of industrial use must be robust, in other words they must run day and night without any major disruptions. It's exactly concerning this point where many laboratory ideas have failed. One of the project's explicit goals was that the processes must also withstand harsh industrial environments. The results are quite impressive – the fabrics of interest can be processed reliably and reproducibly in both the pilot plant and the industrial system. Furthermore, the low-pressure plasma process can also hold its own as regards costs when compared with conventional processes.

Beside the "simple" transfer of the plasma technology to the textile sector, the project is also intended to help gain more detailed knowledge about this new technology in this branch. The Empa experts are therefore systematically investigating plasma treatments with various gaseous mixtures, textile materials and surface structures. "In this way, we can for the first time make definitive statements concerning the effectiveness of various plasma processes and set the plasma parameters accordingly," explains Guimond. The project led to results which met with great enthusiasm among the participants. Two of the participating companies have already started to treat textiles using plasma technology, and in the next few years would like to bring products based on it to market. The Swiss Innovation Promotion Agency CTI also labels this project as a success story. //

Nano-Cluster Bodensee (NCB)

The Nano-Cluster Bodensee is a network spanning all sectors of industry; it consists of more than 80 companies and R&D institutions in the Euregio Bodensee (Lake Constance European region), all of which develop micro and nanotechnologies for use in products and processes. Also participating as partners are the Swiss State Secretariat for Economic Affairs (SECO) and the cantons of St.Gallen, Appenzell Ausserrhoden, Thurgau, Schaffhausen, Grisons and Zurich. Empa is likewise a member, and in fact board member Xaver Edelmann serves as president of the organisation. *www.ncb.ch*