EPTANOVA: *STRETCHABLE* CONDUCTIVE INKS FOR SMART TEXTILES

In the domain of Smart Textile, i.e. those fabrics or garments whose task is other than decoration or protection from the environment, an interest is growing in *wearable electronics* applications integrated into the garments themselves. The more easily deducible potential use is the monitoring of physiological parameters such as heart and respiratory rate or body temperature in the medical or sports sectors. The added value that these solutions offer is the continuous data detection, as this technology assures an intimately and constantly non-invasive contact with the monitored subject, without interfering with his/her normal everyday activities. The components that typically form a smart system are generally the following:

• the sensors that detect parameters and generate low-intensity electrical signals

• the elaborating device needed to process and/or wireless forward them

• the energy sources

• the circuits that transmit the signals of the sensors to the elaborating component, and the power supply if required

The elaborating device and the energy sources can be positioned so that they do not overconstrain movements (maybe on flexible and removable media), whilst sensors – and especially circuits – have to follow the stresses that the fabric undergoes when used (curving, bending, extension) and withstand washing, as well.

Initially, conductive fibres were mainly used for the realization of the circuits. Now, the focus is on the so-called *stretchable* conductive inks, capable of elastically absorbing the mechanical stresses while keeping a useful level of conductivity. Compared to the meshing of fibres in the fabric, printing actually presents great advantages in terms of economic nature and manufacturing flexibility. Nothing new, since printing is widely used on membrane keyboards, photovoltaic cells and touch screens. Moreover, it is also applied on flexible plastic substrates – and in a few isolated cases on plastic membranes that are subsequently laminated to fabric. The real technological frontier is, however, printing on fabric without the interposition of intermediate layers. This allows maintaining the soft touch and the comfort of the product and encourages the end user's adoption, and in addiction simplifies the manufacturing process.

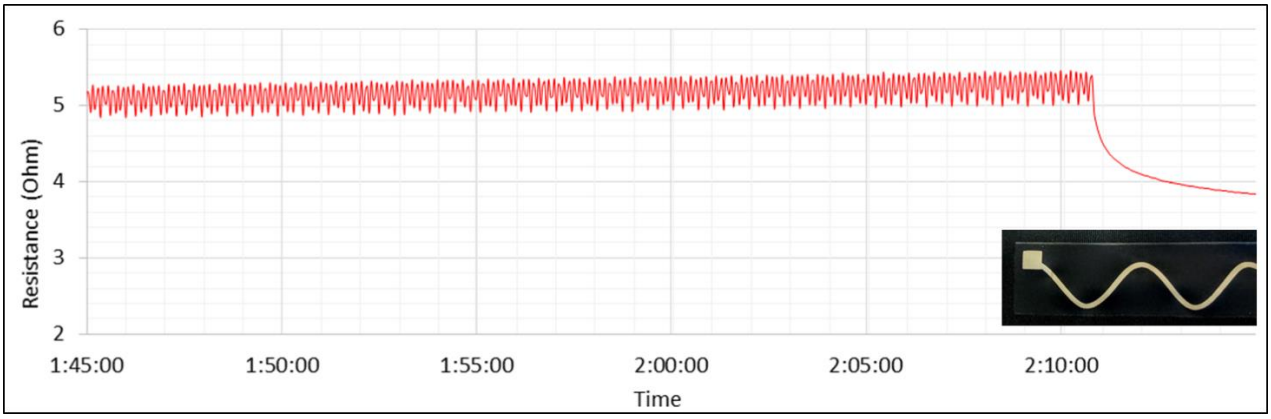
The technological challenges are manifold. The goal is to limit the inevitable deterioration in conductivity of the circuits within acceptable thresholds, when they are solicited by mechanical stresses, such as repeated elongation, and by washing. To date, adequate levels of electrical conductivity can be obtained by using metallic functionalizing materials such as silver. By their very nature, these materials are anything but elastic and not immediately compatible with the ink resins. Furthermore, fabric is a printing substrate having roughness, porosity and dimensional instability that hinder from meeting the accuracy requirements that are in accordance with the production standards of electronic industry.

EPTATECH, an EPTANOVA Company Business Brand, has met this challenge: it has benefitted from the wide know-how of EPTAINKS in textile printing and has developed *stretchable* conductive inks for Smart Textile applications. EPTATECH solution is based on the *transfer printing* technology, which is widely used in textile printing. It consists of printing an ink layer set on a sacrificial substrate – typically made of polyester –, which is removed after heat press transferring on fabric. Transfer printing allows overcoming the fabric dimensional instability problems while printing. For such applications presenting less stringent requirements direct printing is also conceivable.

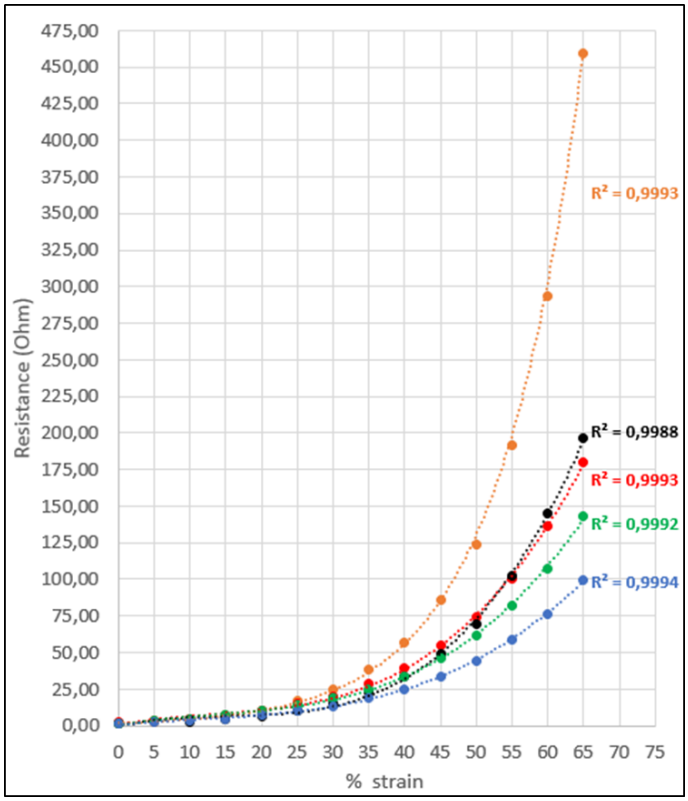
The ink layer set consists of a silver-based conductive ink, which is spread between two outer ink layers having a protective and electrical insulating function. These are water-based inks that can

be screen printed. Through a 55 Th/cm screen mesh an initial resistivity lower than 25 mOhm /sq can be achieved. The diagrams show the typical increase in resistance against stress.

These products are not distributed on a large scale yet, but they are available upon request. During its research and development activities EPTATECH has achieved a specific know-how in printing conductive tracks on different kind of fabrics and is ready to customize its inks. For any further information or to get in direct contact with us, please write to info@eptanova.com and mention “smart textile” in the subject line.



The last 25 minutes of a more than 2 hours non-stop elongation by 10%. The oscillation in the resistance and the definite decay at the end of the test should be noted. In the black box, an example of an examined track is sown.



The resistance trend depending on the elongation %. A comparison between different conductive inks.