**Electrospun fiber coatings as new transparent conductive coatings**

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Transparent conductive coatings (TCC) are used as transparent electrodes for displays, sensors, photovoltaics, transparent heaters, antennas, etc. Mainly, ITO (tin-doped indium oxide) layers are used as TCC, but other materials are also being investigated to replace ITO, such as layers with silver nanowires or silver nanoparticles, graphene, printed metal grids, etc.

Great efforts are being made to obtain flexible and cost-effective transparent conductive coatings that can be produced in a large area.

To obtain flexible and cost-effective transparent conductive coatings with low sheet resistance and high transmission, that can also be produced cost-effectively over a large area, a new technology has been used to produce TCC: the electrospinning process.

Two production routes were investigated:

In the first route, polymer fibers containing silver nanoparticles as nuclei were spun on polymer foil. An electroless silver coating was then applied to obtain conductive fibers. After an additional copper plating, which was performed electroless or galvanically, highly conductive coatings with a sheet resistance of 5 Ω/sq, a total transmittance of about 90 % and a low haze of 2 % or less could be obtained.

In the second route, fibers with a higher metal content were spun on foil, which were already conductive after heat treatment at approx. 100 °C. By subsequent electroless copper plating, sheet resistances of 4 Ω/sq, a total transmission of about 90 % and a low haze of about 2 % were achieved. The second route is advantageous for upscaling to produce large area coatings.

The fiber coatings have a very high aspect ratio: The fibers have a thickness between 1 µm and 3 µm and a length of several cm. The fiber coatings are flexible and stretchable and suitable for flexible devices with a wide range of substrates.

By variation of the spinning parameter and the spinning ink, the thickness and the density of fibers can be adjusted and thus also the resistance and the optical properties.

Various demonstrators, such as a transparent heater and a proximity sensor, have been produced using such electrospun fibers and the results will be presented.

The use of the fibers as a transparent heater was tested with a thermal imaging camera. By heating the electrospun fiber coating with a low power density of about 12 mW/cm2, the temperature of the sample was homogeneously increased from room temperature (21 °C) to about 31 °C. This could be used for de-icing of automotive windows or blades of wind power plants. In addition, a proximity sensor was fabricated to demonstrate the properties of the electrospun fibers.

Possible applications for electrospun fiber coatings are transparent electrodes for flexible displays, sensors, photovoltaics, wearables, antennas, skin patches, antistatic coatings, transparent heaters, etc.

By using a roll-to-roll machine with an electrospinning unit, the fabrication of large area electrospun coatings was shown, which is currently under development to enable industrial applications.