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E-Fibers: Sensor Functionality

EMPA
Materials Science & Technology

Stephen Lawes, Martin Drabik, Katrin Schöller, Dirk Hegemann and Sabyasachi Gaan

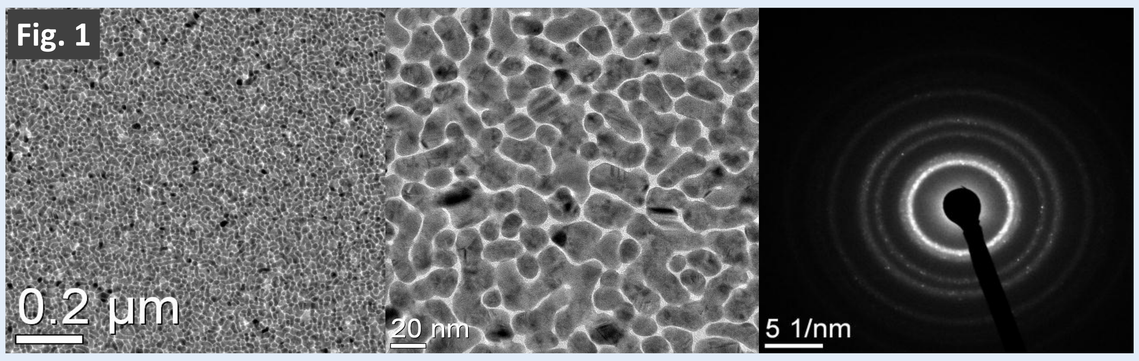
Empa, Swiss Federal Laboratories for Materials Science and Technology, Lerchenfeldstrasse 5, CH-9014 St.Gallen, Switzerland

Introduction

The ability to deposit thin conductive coatings with electronic functionality on single polymer fibers (so-called e-fibers) opens the door to many exciting applications in the field of smart textiles, including wearable electronics, sensors and multiple electrode devices. Metal/plasma polymer nanocomposite coatings attract a long-term interest in research due to the great potential to tune their mechanical, electrical and optical properties according to the requirements of any particular application. Conductive polymer coatings have the advantage of being flexible and are able to form smooth, homogenous layers. PEDOT:PSS is particularly interesting because it is sensitive to external conditions, making it an ideal candidate for pressure and humidity sensors.

Ag/C:H Nanocomposite Coatings for Humidity or Strain Sensors

A change in resistivity can be readily sensed near the percolation threshold (Fig.1), when the plasma polymer matrix of the nanocomposite is exposed to humidity or when an external force is applied.



Using a novel approach, changes in the nanocomposite itself (metal-containing layer) were observed due to the release of metal ions in aqueous environments. Such loss of metallic content can be observed visually, by measurement of optical properties in UV-Vis-NIR spectral regions (Fig.2).

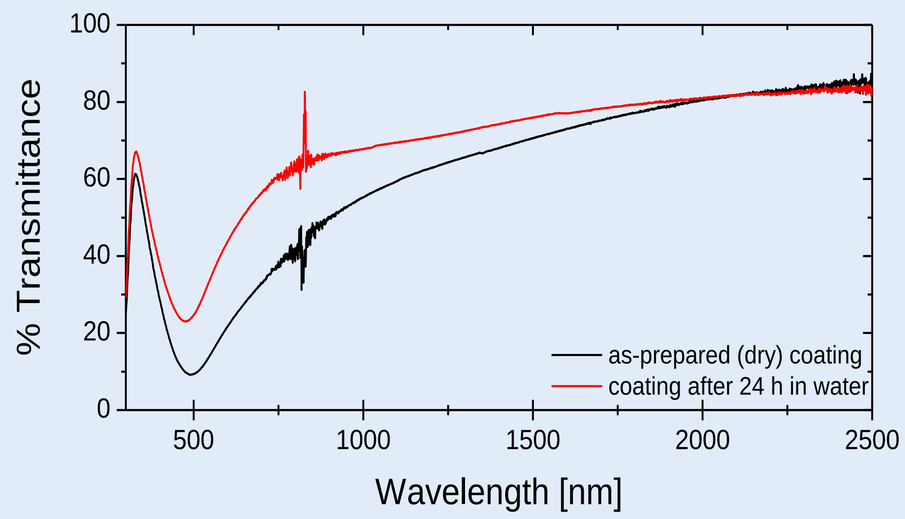


Fig. 2

PEDOT:PSS Coatings on Metallized Fibers for Sensor Applications

Thin Films on Glass

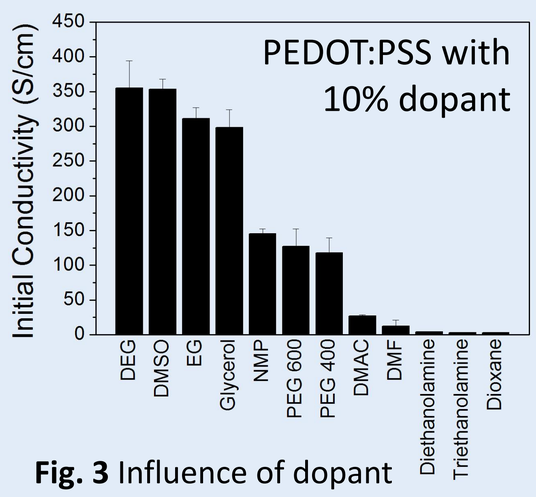


Fig. 3 Influence of dopant

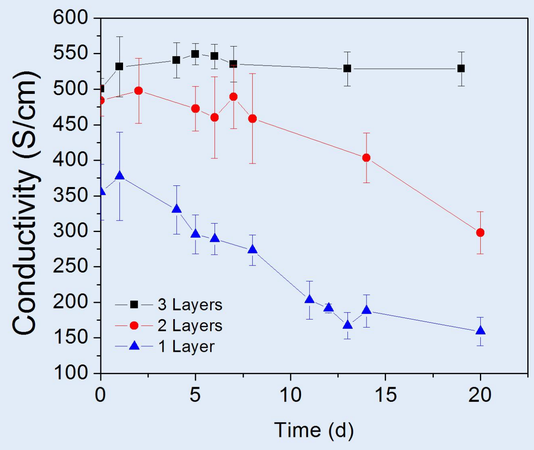


Fig. 4 Effect of multiple layers on stability

Dip-coating

Thin Coatings on Single Fibers

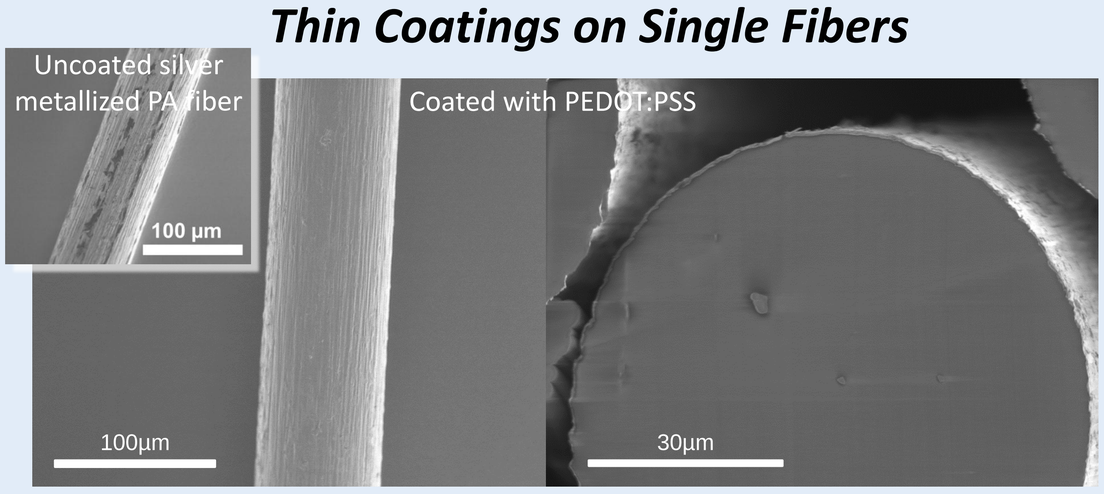


Fig. 5 SEM of thin homogenous PEDOT:PSS coatings on silver metallized PA fibers

Weaving

Conductive Textiles

Wearable Pressure and Humidity Sensors

Conclusions

We have developed a process for making stable, highly conductive PEDOT:PSS coatings on single polymer fibers. These extremely flexible e-fibers have a high potential to be integrated into textiles and fabrics, as they maintain the feel and functionality of traditional textiles. In the case of Ag/C:H plasma polymer nanocomposite coatings, suitable deposition conditions for preparation of films with a percolation structure were determined. Optical properties of the nanocomposite films were characterized in UV, visible and near infra-red (UV-Vis-NIR) spectral regions. Electrical properties and sensor functionality of these films and fibers will be studied in detail shortly.

Contact: martin.drabik@empa.ch (Metal/Plasma Polymer Coatings), katrin.schoeller@empa.ch (PEDOT Coatings)