Development of wearable sensors based on hybrid functional coatings

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The integration of sensors into fabric textiles may represent an important and interesting challenge in materials chemistry for the development of the so-called, "smart textiles", wearable sensors able to react and adapt to specific external environment stimuli from their surroundings. In this regard smart textiles, or e-textiles, describe the convergence of electronics and textiles into fabrics, which are able to sense, compute, communicate and actuate. The inclusion of sensing functions allows the development of new systems still characterized by main textiles properties such as flexibility, comfort, mechanical resistance, and biocompatibility. Thanks to the large number of available sensing molecules and electronic devices, the introduction of the sensor technology in fabric textiles will result in a wide range of daily life applications, such as medical and diagnostic, health care and telemedicine, fitness, sportswear and leisure, wellness, military, police and emergency services equipment, and environmental [1]. As an intermediate interface, wearable sensors have the potential to monitor both the wearer and the environment parameters. Through the integration of novel technologies, flexible supports, like textile fabrics, would be equipped with information and power transmission capabilities, sensing functions, and an infrastructure for embedded wearable microsystems [2]. As many different electronic systems can be connected to any clothing, a wearable sensor system becomes more versatile, innocuous and not interfering with daily activity of the wearer, and the user can change its outfit depending on environmental changes and specific preference.
Opportune nanomaterials such as metal nanoparticles, nanofillers and conducting polymer nanocomposites may be integrated into the flexible coating structure, in order to improve or to develop the desired sensing ability and respond to a stimulus from external optical, electrical, thermal, chemical or magnetic sources. Nanotechnology can provide high durability for fabrics, and in this way, the sol-gel technique or nanocomposites polymerization are promising method exploited to better control the size and shape of the nanostructured 3D network as textile coating [3], and firmly bind to organic functional molecules. This latter is still able to sense the chemical changes in the environment. For this reason, smart textiles have attracted much interest for example as colorimetric sensors able to change color according to specific external stimuli, such as pH, VOC, ionic species and oxygen changes. As a main part of this vision the development of sol-gel pH sensors, based on different dyestuff and on light absorption and/or fluorescence emission, makes them useful devices in many areas, such as medical, environmental or food monitoring [4]. Several reported results show that a certain washing fastness of the obtained coating is reached in any case, and that the sensor films show excellent reproducibility, reversibility and short response times, in the specific dyes or sensing dynamic ranges [5].

References

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