2021-12-11

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Keywords: *textile, contact angle, wettability, fibers, sensors*

Abstract: For the past few decades, wearable electronics have received a lot of attention. Fiber-based electronics, in particular, are thought to be appropriate for a variety of applications due to their flexibility, lightweight, breathability, and comfort. In addition, fibers and fiber-based textiles may be easily integrated into ordinary clothing or accessories. Their flexible and lightweight qualities, on the other hand, provide wearers with more convenient and user-friendly experiences[1]. For continuous health monitoring, wearable sensors use a close interface with human skin and clothing. In the physiological comfort of clothes, particularly sports, active and work wear, the interaction between water and fibers is crucial[2]. Textile and fibers with moisture management properties are desirable. A property of textile which transport the moisture away from body of wearer. People sweat or generate perspiration profusely in a variety of situations, such as in a humid and hot atmosphere or during strenuous exercise. In these situations, an inadequate moisture transport can impact not only thermal-physiological comfort but also cause discomfort and possible skin diseases. Therefore, to maintain the comfort and performance of wearer, it is necessary to select materials with excellent directional moisture transporting and rapid evaporation [3],[4]. These materials should be porous with the wettability gradient.

However, textiles with continuous directional moisture transport and remarkable resistance to water penetration in the opposite direction remains a realistic challenge. In the present our approach is hydrophilicity-hydrophobicity cross plane gradient using ZnO nanomaterials coating as hydrophobic material. Wettability of Coated and no coated threads is measured by contact angle measurement. A flexible ZnO coated threads based sensor is fabricated by dip coating method. Conductive and non-conductive threads are selected for contact angle measurement. These threads include conductive silver-tech 150, black fire fighter cotton and white cotton. Coating solution is prepared by mixing polyvinyl alcohol (PVA) and ZnO. In first step PVA is dissolved slowly in 200ml of deionized water at 80°C under constant magnetic stirring at 600rpm. The stirring is done for 4hrs and now 0.5g of ZnO nanoparticles are added slowly in the mixture at same temperature

but stirring set to 1000rpm.Solution is stirred for 1hr until no sediments seen at the bottom of the beaker. In the second step, threads are dipped in ethanol for 10min.After air drying of samples, they are dipped in the PVA/ZnO solution. Each sample is dipped for 30times.In the final step, samples are placed in the oven overnight at 60°C. Wettability of coated and non-coated threads characterized by measuring contact angle of artificial sweat, saline and deionized water. Static Contact angle is measured according to our previous reported method[5], [6]. All the measurements done at room temperature, 25°C.A customized setup is used for contact angle measurement. It has a high resolution camera which can be attached to laptop through USB port. An anti-vibration plate is used to place camera and a holder to clamp the threads. Liquids under test are dropped vertically using micropipette on threads at the height of 2cm.Volume of tested liquid is kept 3µL.Each experiment is repeated 5times for each liquid with threads. 5 images are captured after 10sec. All the images are captured at different points of threads with different focus and shading. Contact angle calculation is done by imageJ software. Measured contact angle of DI water on nonconductive and conductive threads has shown a variation in contact angle when tested for coated and non-coated threads. The percentage change in contact angle for DI is 57.5% and 40.1% which is showing the hydrophobic behavior of black and white threads after coating, whereas silver-tech 150 hydrophilicity increased by 38%. In case of Artificial sweat, silver-tech 150 and black cotton threads hydrophobicity decreased by 9.2 and 3.5% respectively after coated with ZnO. White cotton thread hydrophobicity increased by 3.4 percent. When threads tested for saline, black cotton coated with ZnO shows a hydrophilic behavior by decreasing hydrophobicity 16percent, white cotton thread hydrophobicity decreased by 6.6 percent whereas silver-tech 150 hydrophobicity increased by 6%. The wetting behaviors of threads changed after coated with ZnO coating. It is concluded that the wetting gradient is possible in threads by carefully coating them with ZnO nanoparticles. Also surface roughness of threads contribute towards non uniform coating of ZnO which ultimately affects the contact angle measurement. The results present research contributes in surface modification of threads in a simple way.