Scalable Power Generation for Wearable Electronics Using Fabric Electrochemistry

Raman Vilkhu [1], Cody O'Connor [1], Wesley Thio [2], Piya Das Ghatak [3], Anne Co [2], Chandan K. Sen [3], and Asimina Kiourti [1]
(1) Department of Electrical and Computer Engineering, The Ohio State University, Columbus, OH, 43210
(2) Department of Chemistry, The Ohio State University, Columbus, OH, 43210
(3) Department of Surgery, The Ohio State University, Columbus, OH, 43210

We introduce a new class of electrochemical fabrics which, when moistened by a conductive bodily liquid (sweat, wound exudate, etc.), generate DC voltages and current levels capable of powering wearable electronics. Contrary to conventional power generation techniques, the proposed electrochemical fabrics are fully flexible, feel and behave like regular clothing, do not include any heavy or rigid components, and provide DC power via moistening by readily available conductive bodily liquids. Generation of DC power is achieved via an electrochemical process that enables the transfer of electrons from Zinc to Silver Oxide-printed electrodes (anodes and cathodes), using the conductive liquid as an electrolyte. These anodes and cathodes are 'printed' onto the flexible fabrics with the use of polyvinyl binders, which facilitate the adhesion of the solid metal electrodes to the fabric surface. Flexible inter-connections between several of the aforementioned 'printed' battery cells are also proposed for scaling the generated DC power, per the application requirements. Such power scaling measures could be utilized to design an electrochemical fabric capable of powering a wireless epidermal or body-worn sensor out of thin air. As a proof-of-concept, we demonstrate that voltage and current levels as high as 1.4 V and 50 μA, respectively, can be generated via two of the aforementioned 'printed' battery cells connected in series. Notably, this combination has been shown to turn 'ON' a digital thermometer's display. Overall, the proposed technology is expected to be of utmost significance for powering electronics in several military, healthcare (e.g. electroceutical), entertainment, arts, sports, and emergency applications, among others.