Flexible SiNWs-based thermoelectric generators for healthcare monitoring

Darwin Caina[1,2], Georgiana Sandu[1], and Sorin Melinte[1*]

[1]Institute of Information and Communication Technologies, Electronics and Applied Mathematics, Université catholique de Louvain, 1348, Louvain-la-Neuve, Belgium.

[2] Facultad de Ingeniería, Ciencias Físicas y Matemática, Universidad Central del Ecuador, Quito, Ecuador.

[*]Contact: sorin.melinte@uclouvain.be

Wearable devices for healthcare monitoring applications need reliable and miniaturized electrical power supplies. Human skin, involved in the regulation of the body temperature, can be exploited to harvest thermal energy in order to enable smart power sources. Converting heat into electricity requires a highly efficient thermoelectric generator (TEG) to facilitate adequate intake of the human skin thermal signature. For this purpose, silicon nanowires (SiNWs) have emerged as a promising material since nanofabrication allowed Si one-dimensional nanostructures to achieve good thermoelectric properties such as: high Seebeck coefficient, high electrical conductivity, and low thermal conductivity. A high thermal to electrical conversion efficiency can be achieved with SiNWs-based TEGs. Such TEGs require a thermoelectric couple based on *n*-type and *p*-type SiNWs that exploits the Seebeck effect. Here, we report on different techniques to improve the dimensionless figure of merit (zT) of SiNWs. For instance, zT can be altered by blending SiNWs with a polymer, for example, poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate), thus, lowering thermal conductivity. Measurements are sustained by numerical modeling and discussed within a general theoretical framework for SiNWs. Specifically, an array of SiNWs-based TEGs, interconnected according to electrical power levels required by electro-thermal drug delivery patches, is integrated on a human-skin compatible platform using polyethylene terephthalate as a substrate.