Seebeck-Watch: Development of a Nano and Microtechnological Method for Constructing Wristwatch Systems Through Temperature Difference

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Nowadays, 1% of the total garbage in cities worldwide comes from non-rechargeable batteries and piles. These sources of energy are used primarily in wristwatches. Thus, the research focused on developing an innovative sustainable system for wristwatches through thermoelectric thin films and a microelectronic circuit that converts the temperature difference between the human wrist and the environment into voltage and the microelectronic circuit. Preparing the thermoelectric thin film, bismuth telluride based on antimony and selenium was chosen as the semiconductors and the copper target, to be deposited, respectively, by Flash Deposition and Sputtering. Furthermore, its intrinsic properties were evaluated, such as electrical and thermal conductivity, Seebeck coefficient, XRD and EDX, thin-film surface properties (AFM and SEM), and adhesion analysis. Regarding the electronic micro-circuit, its prototype PCB dimensions are 16.6mm x 12.7mm, allowing the size to be used in most wristwatches and converting 20 mV into 3.3V. Based on the chosen methods, verifying the microelectronic circuit working and comparing it to a wristwatch operating, the voltage value obtained was 3.3V or 4.1V. It's able to power a smartwatch. The thermoelectric thin film's intrinsic properties and mechanical results made it possible to apply it to the human wrist, having sheet resistance of 8 Ohm/sq and 18 Ohm/sq for type-N and type-P semiconductors, respectively. Still, as the adhesion over the prototype hasn't changed considerably in all the thin-film materials, its excellent mechanical properties can remain throughout all user´s life. Finally, the cost of the developed sustainable system was $17.64, which is about 10 to 40 times lower than area applications implemented on a macro scale.

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