Oral Session 7: Thermoelectric Generators Initiative: Setup development, geometry and device characterization - Gustavo Dalkiranis (USP)

Description

The energy crisis and global climate change are a reality that must be urgently addressed. Raising awareness through international agreements is a very powerful way of educating society, but nothing will change if new, renewable and efficient technologies emerge to replace the dominance of fossil fuels. Knowing that 60% of the energy produced is lost in the form of heat in most of industrial/domestic process, to recover this lost energy is a way to help addressing this problem [1]. In this context, thermoelectric materials, which can convert heat into electrical energy through the Seebeck Effect, are important candidates to generate a clean and renewable energy [2,3]. For the application of these materials in energy generators, it is important to determine their thermoelectric properties, that is, Seebeck coefficient, electrical and thermal conductivities. Therefore, a thorough measurement setup to determine the Seebeck coefficient and electrical conductivity of polymeric thin films was fully developed in this work. The in-house assembled system was validated by measuring the thermoelectric properties of PEDOT:PSS thin films, a well-known prototype material within Organic Electronics and thermoelectric generators alike. However, such devices still have low conversion efficiency, which prevents their wide application to obtain clean energy [3]. In order to obtain highly efficient thermoelectric devices, a simulated-based study was conducted to optimize the device geometry, in terms of its efficiency. Here, two geometries, filled and hollow, with the same cross-sectional area (fill factor), were explored and simulated using the finite element method (FEM). The simulations revealed an increase in efficiency of devices with hollow geometries, when compared to the ones with filled forms. Such behavior was observed for thermoelectric devices with lengths smaller than 0.1mm, where the change in the geometric shape alters the distribution of the temperature differences across the device. These results pave the way for new developments of highly efficient miniaturized thermoelectric generators.

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References

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[3] SHITTU, Samson; LI, Guiqiang; ZHAO, Xudong; MA, Xiaoli. Review of thermoelectric geometry and structure optimization for performance enhancement. Applied Energy, [S.I.], v. 268, n. 115075, p. 1-31, jun. 2020.Recolher

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