Analysis of the internal heat losses in a thermoelectric generator

A 3D thermoelectric numerical model is used to investigate different internal heat loss mechanisms for a thermoelectric generator with bismuth telluride p- and n-legs. The model considers all thermoelectric effects, temperature dependent material parameters and simultaneous convective, conductive and radiative heat losses, including surface to surface radiation. For radiative heat losses it is shown that for the temperatures considered here, surface to ambient radiation is a good approximation of the heat loss. For conductive heat transfer the module efficiency is shown to be comparable to the case of radiative losses. Finally, heat losses due to internal natural convection in the module is shown to be negligible for the millimetre sized modules considered here. The combined case of radiative and conductive heat transfer resulted in the lowest efficiency. The optimized load resistance is found to decrease for increased heat loss. The leg dimensions are varied for all heat losses cases and it is shown that the ideal way to construct a TEG module with minimal heat losses and maximum efficiency is to either use a good insulating material between the legs or evacuate the module completely, and use small and wide legs closely spaced. (C) 2014 Elsevier Masson SAS. All rights reserved.