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Doktorand für energy harvesting mit Formgedächtnismaterialien

Helmholtz-Zentrum Dresden-Rossendorf

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Efficiency-Optimized Setup for Low Grade Waste Heat Harvesting with Shape Memory Alloys

More than half of all energy converted by humankind is lost in the form of waste heat. Not only does that strongly contribute to the acceleration of global warming [1], it also leaves an enormous economic potential untouched. However, suitable technologies are limited [2], since most of this heat is of low temperature (‹ 100 °C) [3] and low grade. In the last years, materials and technologies for thermoelectric harvesting and thermomagnetic harvesting have been explored, but reaching a high efficiency of those systems remains a challenge. With our work, we present a thermoelastic harvesting approach for converting the waste heat of a fluid into electricity, utilizing Nickel-Titanium wires. The inherent advantage of a higher material efficiency than thermoelectrics [4,5], together with the possibility to adapt the wires to the desired temperature range via alloying and prestrain, and the commercial availability of the material makes NiTi a solid candidate for a waste heat harvesting system. The core structure of our harvesting system is a newly developed design for a fluid chamber. With the use of coupled FEM-Simulations we optimized the heat exchange process between a thermal fluid and the wire and therefore max- imized the thermodynamic efficiency of the thermal energy to mechanical energy conversion (32 % of Carnot). In this work, we show our approach in optimizing the heat exchange between the fluid and the wire and the influence of parameters, like preload and waste heat temperature, on the efficiency of the system.

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