Proceedings of the 10th World Congress on Mechanical, Chemical, and Material Engineering (MCM'24)
Barcelona, Spain –August 22-24, 2024
Paper No. HTFF 210
DOI: 10.11159/htff24.210

Cooling With Magnets-Proving the Concept of Cascaded Caloric Heat Pipes

Schipper Jan[1], Bartholomé Kilian[2], Unmüßig Sabrina[2], Jürgen Wöllenstein[1,2]
[1]IMTEK Uni Freiburg
Georges-Köhler-Allee 103, Freiburg im Breisgau, Germany
jan.schipper@imtek.uni-freiburg.de; kilian.bartholome@ipm.fraunhofer.de
[2]Fraunhofer IPM
Georges-Köhler-Allee 301, Freiburg im Breisgau, Germany

Extended Abstract

Heating and cooling make up a large portion of our total energy consumptions. Today most use cases are being addressed by conventional vapor compression systems. These vapor compression systems rely on harmful or explosive refrigerants and typically achieve less than 50% of Carnot efficiency. An alternative option are magneto caloric systems. These use solid state refrigerants that exhibit a temperature change corresponding to a magnetic field change. As shown in a recent study by Schipper et al. [1] these types of systems have the potential to be more efficient than conventional vapor compression systems. One type of magneto caloric cooling system is the active magneto caloric heat pipe. Unlike other concepts it uses evaporation and condensation as a heat transfer method. This has proven to lead to increase the specific cooling power by almost an order of magnitude and thereby lowering system costs [2] . However, the original prototype achieved only a temperature difference less than 2 K and 42 W of cooling power.
For this study a cascaded system consisting of seven sequential caloric segments connected by check-valves was build. With this design we were able to increase the maximum temperature difference to 11.5K and the maximum cooling power to 130W. The design was studied using both ethanol as well as methanol as the heat transfer fluid.

References

[1] ADDIN CitaviBibliographySchipper, J.; Bach, D.; Mönch, S.; Molin, C.; Gebhardt, S.; Wöllenstein, J.; Schäfer-Welsen, O.; Vogel, C.; Langebach, R.; Bartholomé, K. On the efficiency of caloric materials in direct comparison with exergetic grades of compressors. J. Phys. Energy 2023, 5, 45002, doi:10.1088/2515-7655/ace7f4.
[2] Maier, L.M.; Corhan, P.; Barcza, A.; Vieyra, H.A.; Vogel, C.; Koenig, J.D.; Schäfer-Welsen, O.; Wöllenstein, J.; Bartholomé, K. Active magnetocaloric heat pipes provide enhanced specific power of caloric refrigeration. *Commun Phys* **2020**, *3*, 1–6, doi:10.1038/s42005-020-00450-x.