

Accepted Manuscript

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PII: S1359-4311(16)32025-7

DOI: <http://dx.doi.org/10.1016/j.applthermaleng.2016.09.164>

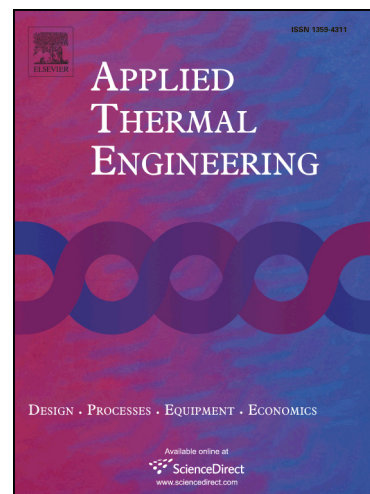
Reference: ATE 9189

To appear in: *Applied Thermal Engineering*

Received Date: 25 May 2016

Revised Date: 28 September 2016

Accepted Date: 29 September 2016



Please cite this article as: Z. Xie, G. Sebald, D. Guyomar, Comparison of elastocaloric effect of natural rubber with other caloric effects on different-scale cooling application cases, *Applied Thermal Engineering* (2016), doi: <http://dx.doi.org/10.1016/j.applthermaleng.2016.09.164>

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Comparison of elastocaloric effect of natural rubber with other caloric effects on different-scale cooling application cases

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Highlights

- Caloric materials for different-scale cooling applications;
- Environmental issues for caloric materials;
- Natural rubber for large-scale cooling applications;

Abstract

In the framework of solid-state cooling technologies, four kinds of caloric effects, i.e., magnetocaloric (MC), electrocaloric (EC), barocaloric (BC) and elastocaloric (eC) effects, have been compared from the viewpoint of environmental issues and application cases. This field is primarily developed with the intention of protecting the environment. Currently, alternative caloric materials (called “good” materials) with properties such as being environmentally friendly, low-cost and practicable (low stimulus field) need to be found. All current caloric effects/materials are investigated for the common objective of cooling. Due to the variety of stimuli and intrinsic properties (different caloric performances for different dimensions) of caloric materials, they can exhibit unique advantages for various application cases. A “good” caloric material for large-scale cooling application is still rare and requires more research.

Keywords: solid-state cooling; caloric effect; different-scale cooling application cases;

1. Introduction

The environmental issue is becoming more and more prominent. It has mainly originated from the development of industrial technology, where the high performance objective might be non-sustainable. It is important to use environmental standards as the primary criterion for technological development. Nowadays, the refrigeration market is large and keeps growing. Vapor-compression has been the dominant technology for all cooling applications during the past 100 years. Although its cooling performance is improving, the fact that it is based on hazardous gas remains unchanged. This has resulted in several environmental problems. For example, the global warming potential (GWP) of the conventional refrigerants (hazardous gases) used in vapor-compression equipment is as high as 1000-2000 times that of CO₂ [1].

Solid-state cooling technologies based on caloric effects are drawing more and more attention. These caloric effects include mainly magnetocaloric (MC), electrocaloric (EC), barocaloric (BC) and elastocaloric (eC) actions. They refer to the change in isothermal entropy or adiabatic temperature upon application or removal of a magnetic field, an electrical field, hydrostatic pressure and uniaxial

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