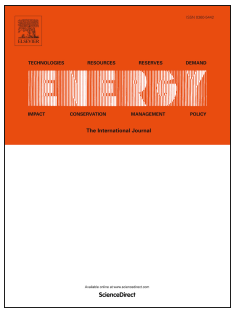
Accepted Manuscript



Numerical modeling of an active elastocaloric regenerator refrigerator with phase transformation kinetics and the matching principle for materials selection

Suxin Qian, Lifen Yuan, Jianlin Yu, Gang Yan

PII: S0360-5442(17)31636-5

DOI: 10.1016/j.energy.2017.09.116

Reference: EGY 11610

To appear in: *Energy*

Received Date: 25 May 2017

Revised Date: 4 September 2017

Accepted Date: 24 September 2017

Please cite this article as: Qian S, Yuan L, Yu J, Yan G, Numerical modeling of an active elastocaloric regenerator refrigerator with phase transformation kinetics and the matching principle for materials selection, *Energy* (2017), doi: 10.1016/j.energy.2017.09.116.

Numerical modeling of an active elastocaloric regenerator refrigerator with phase transformation kinetics and the matching principle for materials selection

Suxin Qian*, Lifen Yuan, Jianlin Yu, Gang Yan

Department of Refrigeration and Cryogenic Engineering, School of Power and Energy Engineering, Xi'an Jiaotong University, Shaanxi, China 710049

*Corresponding Author

Tel: (+86) 29 - 82668738, Fax: (+86) 29 - 82668725, Email: qiansuxin@xjtu.edu.cn

Abstract

Elastocaloric cooling technology is a novel solid-state cooling technology based on the latent heat associated with martensitic phase transformation in shape memory alloys. The active elastocaloric regenerator concept was recently demonstrated as a promising approach for this technology. However, if not properly designed, the large temperature gradient in the active regenerators could lead to significant degradation of elastocaloric effect and system performance. To address this challenge, a numerical model was developed in this study with phase transformation kinetics of shape memory alloys, which is capable to investigate the stress-induced or temperature-induced phase change phenomena and elastocaloric effect degradation problem. The performance of an elastocaloric cooling system with a pair of active regenerators is studied in terms of operating frequency, flow rate, geometric parameters and thermal conductivity of the material. Most importantly, the condition to avoid eCE degradation was found as the matching principle to guide material selection for future studies.

Key words: solid-state cooling, elastocaloric cooling, thermoelastic cooling, shape memory alloys, phase transformation model

Nomenclature

AER	active elastocaloric regenerator