

Accepted Manuscript

Numerical analysis on the energy storage efficiency of phase change material embedded in finned metal foam with graded porosity

Feng Zhu, Chuan Zhang, Xiaolu Gong

PII: S1359-4311(16)32327-4

DOI: <http://dx.doi.org/10.1016/j.applthermaleng.2017.05.075>

Reference: ATE 10387

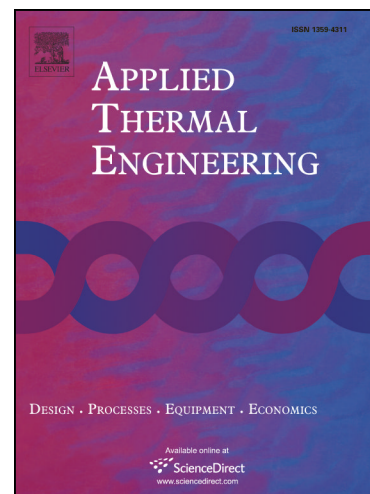
To appear in: *Applied Thermal Engineering*

Received Date: 10 October 2016

Accepted Date: 13 May 2017

Please cite this article as: F. Zhu, C. Zhang, X. Gong, Numerical analysis on the energy storage efficiency of phase change material embedded in finned metal foam with graded porosity, *Applied Thermal Engineering* (2017), doi: <http://dx.doi.org/10.1016/j.applthermaleng.2017.05.075>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



Numerical analysis on the energy storage efficiency of phase change material embedded in finned metal foam with graded porosity

Feng ZHU, Chuan ZHANG, Xiaolu GONG*

Charles Delaunay Institute, Laboratory of Mechanical System and Simultaneous Engineering, University of Technology of Troyes, UMR CNRS 6281, 12 Rue Marie Curie, 10004 Troyes, France

(* Correspondent author; Tel: 33 3 25 71 56 70 Fax: 33 3 25 71 56 75

e-mail: gong@utt.fr

Abstract

The metal foam/phase change material (PCM) composite is a promising material in the thermal energy storage system. In the present study, a modified structure of metal foam, finned metal foam with graded porosity (FFGP), is proposed to further accelerate the melting process of the composite. The finite volume method and two equations model are applied in the modeling of FFGP. The average power of energy storage is defined to evaluate the energy storage efficiency of the composite. The effects of the structural parameters of FFGP on the average power of energy storage are investigated, including thickness of metal fin, porosity gradient of metal foam and pore per inch (PPI). The results indicate that FFGP structure could reduce the total melting time and enhance greatly the energy storage performance. This is because the metal fin changes the melting sequence of PCM and the gradient metal foam contributes to the heat transfer between the heat source and the composite. Besides, the value of PPI has a great impact on natural convection in the composite. Through combining the proper metal fin, gradient metal foam and PPI, the FFGP structure with the good performance could be obtained.

Keywords: metal foam; graded porosity; metal fin; phase change material; heat transfer enhancement

Nomenclature

Symbols			
A	interfacial area density (m^{-1})	T_{m2}	upper melting temperature, K
C	consecutive number	U	velocity field, (m s^{-1})
C_l	specific heat of liquid phase ($\text{J kg}^{-1} \text{K}^{-1}$)	x,y	Cartesian coordinates
C_s	specific heat of solid phase ($\text{J kg}^{-1} \text{K}^{-1}$)	<i>Greek symbols</i>	
d_f	cell ligament diameter (m)	α	constant number
d_p	cell pore average diameter (m)	β	volume fraction of the liquid
e	energy saturation (%)	λ	thermal conductivity ($\text{W m}^{-1} \text{K}^{-1}$)
E	energy (J)	Δ	porosity gradient (%)
F	term source	ρ	density (kg m^{-3})
g	gravity (m s^{-2})	ε	porosity (%)
Gr	Grashof number	μ	dynamic viscosity ($\text{kg m}^{-1} \text{s}^{-1}$)
h	heat transfer coefficient ($\text{W m}^{-2} \text{K}^{-1}$)	γ	thermal expansion coefficient (K^{-1})
H	thickness of fin (mm)		
K	permeability (m^2)		

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات