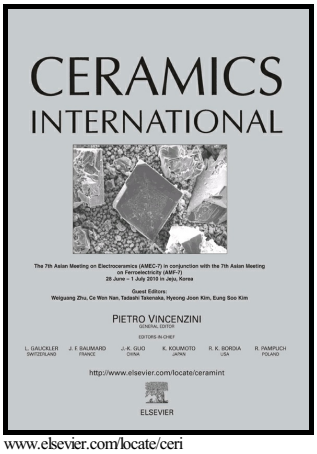

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PII: S0272-8842(16)32386-0
DOI: http://dx.doi.org/10.1016/j.ceramint.2016.12.119
Reference: CERI14429

To appear in: *Ceramics International*

Received date: 23 October 2016
Revised date: 11 December 2016
Accepted date: 23 December 2016

Cite this article as: Xinbin Lao, Xiaohong Xu, Jianfeng Wu and Xiaoyang Xu High-temperature alloy/honeycomb ceramic composite materials for sola thermal storage applications: preparation and stability evaluation, *Ceramic International,* http://dx.doi.org/10.1016/j.ceramint.2016.12.119

High-temperature alloy/honeycomb ceramic composite materials for solar thermal storage applications: preparation and stability evaluation

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Abstract:

SiC_w/Al_2O_3 honeycomb ceramics were engaged as sensible shell materials for encapsulating Al-Si alloys (latent heat materials) in the honeycomb holes to obtain alloy/ceramic composite materials with a high thermal storage capacity for high-temperature solar thermal storage applications. The stability evaluation between the sensible honeycomb ceramics and the latent alloys had been conducted and the failure mechanism for the latent alloys was investigated. Results indicated that the addition of the latent alloys could improve the thermal storage capacity of the sensible honeycomb ceramics significantly by >114% and the thermal storage densities of honeycombs containing Al-12Si and Al-20Si alloys were 1141.3 kJ/kg and 1106 kJ/kg (400-900 °C), respectively. The composite materials exhibited excellent physical and chemical stability. No cracks formed in the honeycomb ceramics and no leakage of alloys was discovered after the composite materials were exposed to 100 thermal cycles in a high-temperature testing environment. The oxidation of Al at >600 °C would lower the latent heat of alloys and the thermal storage densities decreased to 1039.9 kJ/kg and 1013.2 kJ/kg after enduring 100 thermal cycles. This study