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www.elsevier.com/locate/ceri

PII: S0272-8842(17)30032-9  
DOI: <http://dx.doi.org/10.1016/j.ceramint.2017.01.020>  
Reference: CERI14482

To appear in: *Ceramics International*

Received date: 26 October 2016  
Revised date: 2 January 2017  
Accepted date: 5 January 2017

Cite this article as: Hiroyuki Miyazakia, Shoji Iwakiri, Kiyoshi Hirao, Shinji Fukuda, Noriya Izu, Yu-ichi Yoshizawa and Hideki Hyuga, Effect of high temperature cycling on both crack formation in ceramics and delamination of copper layers in silicon nitride active metal brazing substrates, *Ceramics International*, <http://dx.doi.org/10.1016/j.ceramint.2017.01.020>

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Effect of high temperature cycling on both crack formation in ceramics and delamination of copper layers in silicon nitride active metal brazing substrates

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## Abstract

Crack formation in  $\text{Si}_3\text{N}_4$  active metal brazing (AMB) ceramic substrates and delamination of copper layers on the AMB substrates subjected to temperature cycling from -40 to 250 °C were investigated to evaluate the reliability of these substrates under harsh environments. Acoustic scanning microscopy (ASM) observation of the  $\text{Si}_3\text{N}_4$  substrates with 0.30 mm thick Cu layers revealed crack formation beneath the corner of the copper plate after 100 cycles, whereas no cracks were detected on the  $\text{Si}_3\text{N}_4$  substrate with a 0.15 mm thick Cu layer, even after 1000 cycles. The residual bending strength of the  $\text{Si}_3\text{N}_4$  substrates with 0.30 mm thick Cu layers was 78% of the as-received substrate after 10 thermal cycles, and gradually decreased with an increase in the number of thermal cycles until ca. 65% of the initial strength after 1000 cycles. The  $\text{Si}_3\text{N}_4$  substrates with 0.15 mm thick Cu layers exhibited a gentler degradation of residual strength than those with 0.30 mm thick Cu layers. In contrast, the residual bending strength of AlN-AMB substrates

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