Cu-Bi Alloys with High Volume Fraction of Bi: A Material Potentially Suitable for Thermal Surge Protection and Energy Storage

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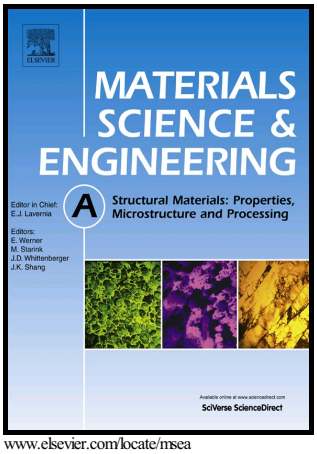

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Cu-Bi Alloys with High Volume Fraction of Bi: A Material Potentially Suitable for Thermal Surge Protection and Energy Storage

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Abstract

Thermal energy storage and surge protection materials store surplus heat energy and inhibit the increase in the temperature of materials in case of excess energy generation or surge. This study explores usage of Cu-Bi alloys comprising high volume fraction of Bi for energy storage and surge protection. Cu-Bi alloys, comprising 20, 40 and 60 vol. % of Bi, are prepared using liquid phase sintering by heating a mixture of Cu and Bi powders above the melting temperature of Bi, $T_{m,Bi}$. Compression testing of Cu-Bi alloys is conducted at temperatures above and below $T_{m,Bi}$. It is observed that the flow stress, yield stress, stress exponent and strain hardening exponent drastically decrease above $T_{m,Bi}$. In addition, compression creep testing is performed for Cu-40 vol. % Bi at temperatures above and below $T_{m,Bi}$. The experimental results establish that this alloy can sustain moderate level of stresses at temperatures above $T_{m,Bi}$ for long periods. Moreover, differential scanning calorimetry is employed to evaluate the heat storage capacity of the alloy with different compositions and effect of cyclic heating and cooling on the heat storage capacity. It is observed that the heat storage capacity of Cu-Bi alloy remains almost constant for several melting-solidification cycles. Finally, it is suggested that Cu-Bi alloy containing high volume fraction of Bi can be used for energy storage and thermal surge protection.

Keywords: Cu-Bi alloy; Energy storage; Mechanical behavior; Thermal surge protection

1. Introduction