Accepted Manuscript

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PII: S0925-8388(18)30544-9

DOI: 10.1016/j.jallcom.2018.02.103

Reference: JALCOM 44979

To appear in: *Journal of Alloys and Compounds*

Received Date: 15 November 2017

Revised Date: 8 February 2018

Accepted Date: 9 February 2018

Please cite this article as: J.I. Rojas, B.V. Siva, K.L. Sahoo, D. Crespo, Viscoelastic behavior of a novel aluminum metal matrix composite and comparison with pure aluminum, aluminum alloys, and a composite made of Al–Mg–Si alloy reinforced with SiC particles, *Journal of Alloys and Compounds* (2018), doi: 10.1016/j.jallcom.2018.02.103.

Viscoelastic behavior of a novel aluminum metal matrix composite and comparison with pure aluminum, aluminum alloys, and a composite made of Al–Mg–Si alloy reinforced with SiC particles

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Abstract

The viscoelastic response of a novel composite (A356 aluminum alloy matrix with ceramic reinforcement particles developed from colliery shale waste) is measured with dynamic-mechanical analyzer, and is compared to pure aluminum, aluminum alloys A356, 7075 and 2024, and another composite (6061 aluminum alloy matrix reinforced with SiC particles). The studied materials show some common features but the novel composite is one of the most stable (a rapid decrease in stiffness starts only at very high temperature). Moreover, compared to the A356 alloy, the composite shows higher stiffness (since the reinforcement particles are stiffer than the A356 matrix and may foster precipitation hardening) and higher mechanical damping/internal friction (likely due to relaxations associated with the reinforcement particles and to the larger grain size for the A356 alloy). A typical relaxation peak in aluminum attributed to grain boundary sliding is suppressed in the composite because the reinforcement particles pin the grain boundaries.

Keywords metal matrix composites; grain boundaries; mechanical properties; microstructure; optical spectroscopy; scanning electron microscopy, SEM