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Jose I. Rojas, Bathula Venkata Siva, Kanai Lal Sahoo, Daniel Crespo



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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

Jose I. Rojas^a, Bathula Venkata Siva^b, Kanai Lal Sahoo^c and Daniel Crespo^d

^a Department of Physics – Division of Aerospace Engineering, Universitat Politècnica de Catalunya; c/ Esteve Terradas 7, 08860, Castelldefels (Spain); corresponding author: email: josep.ignasi.rojas@upc.edu; phone: +34 93 413 4130; fax: +34 93 413 7007

^b Department of Mechanical Engineering, Narasaraopeta Engineering College; Narasaraopet, Andhra Pradesh, 522601 (India); email: venkatasivanec@gmail.com

^c Council of Scientific and Industrial Research (CSIR), National Metallurgical Laboratory; Jamshedpur, Jharkhand, 831007 (India), email: klsah@nmlindia.org

^d Department of Physics, Universitat Politècnica de Catalunya; c/ Esteve Terradas 7, 08860, Castelldefels (Spain); email: daniel.crespo@upc.edu; phone: +34 93 413 4141, fax: +34 934 137 007

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

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