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In Situ Analysis of Incipient Melting in a Novel High Strength Al–Cu Cast Alloy Using Laser Scanning Confocal Microscopy (LSCM)

Bernoulli Andilab, Comondore Ravindran and Neslihan Dogan

Abstract Incipient melting in a novel Al–Cu alloy was investigated. Overheating during heat treatment leads to incipient melting thereby compromising mechanical properties. Advanced microscopy and real-time imaging techniques such as high-temperature LSCM enable a direct in situ observation of incipient melting and phase transformations. Hence, isothermal analysis was carried out using LSCM at elevated temperatures to analyze incipient melting with time. The predominant phase of this alloy was Al_2Cu in both blocky and eutectic morphologies. The results showed that incipient melting was accompanied by a clustering of liquid droplets followed by a complete melting of Al_2Cu at approximately 548 °C. The in situ analysis also revealed that eutectic Al–Al_2Cu was found to melt prior to blocky Al_2Cu. Further, localized melting was also observed to occur at a random sequence. As a result of incipient melting, the microstructure consisted of a proliferation of defects such as brittle ultra-fine eutectic clusters and porosity.

Keywords Laser scanning confocal microscopy · Al alloys · Incipient melting · Heat treatment

Introduction

The development of lightweight engineering materials with superior properties has become a necessity due to the mitigating effects on automotive emissions. Aluminum (Al) alloys, due to their high strength to weight ratio, enable increased fuel efficiency of automotive vehicles and currently play a role in developing new generation highly efficient electric vehicles. Al–Cu alloys such as the B206 alloy are commonly used in the automotive industry. In the T7 heat treated condition, the alloy exhibits excellent mechanical properties similar to that of ductile iron, but with one-third of density

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