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Microstructure Evolution in Thermally Managed Carbon and Graphite Fiber Reinforced Aluminum Alloys

성환구†, H.F.Lopez*, Marija Gajdardziska-Josifovska*, P. Rohatgi*, 허보영**

아이큐브 사업단, 경상대학교; *University of Wisconsin-Milwaukee; **경상대학교 나노 신소재 공학부

(uw98hgs@gnu.ac.kr†)

The effect of external heat extraction through reinforcing fibers on the solidification morphology and nucleation was examined in graphite fiber reinforced 2014 aluminum alloys processed through a squeeze casting. In order to enhance the local solidification rate of the matrix alloy, the carbon and graphite fibers were externally cooled by exposing their ends to ambient air during squeeze pressure infiltration. The resultant solidification morphologies in assistance with composition measurements and nucleation were characterized by analytical instruments. The detailed microstructures exhibited significant differences in fiber reinforced matrices between carbon and graphite fiber aluminum alloy composites; the columnar-like solid arms were developed in the carbon fiber reinforced matrices, while in the graphite fiber reinforced matrices the planar-like solid arms were evolved. It was apparent that external heat extraction though the reinforcing graphite fibers led to the formation of single alpha-Al envelops onthe fiber surfaces and then relatively small extent of solute microsegregation compared to that of the carbon fiber composite. High resolution transmission electron microscopy (HRTEM) used to characterize the interface structure uncovered $(002)_{\alpha\text{-Al}}$ //$(0002)_{GR}$ orientation relationship at the α-Al/graphite fiber interfaces.

Keywords: external heat extraction, infiltration, microsegregation, nucleation

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Effects of Mircostructure and Crystallographic Orientation on the Deformation Behavior of Ni/Ni_3Al Single Crystals

송성훈, Kyosuke Kishida*, Masahiko Demura**, Toshiyuki Hirano**, 김민철***, 오명훈****, 위당문†

KAIST; *Kyoto University; **NIMS(일본물질재료연구기구); ***한국원자력연구소; ****금오공과대학교

(wee@kaist.ac.kr†)

In order to study the deformation behavior depending on the initial crystallographic orientations and the morphology of Ni_3Al precipitates, the plane strain compression tests were carried out on the single crystals of Ni/Ni_3Al (Ni-18at.%Al) two-phase alloys. Flow behaviors were strongly dependent on the initial crystallographic orientations in DS18-3 alloys with rods and plates of Ni_3Al precipitates rather than DS18-1 alloys with Ni_3Al cuboids. For all orientations of DS18-1 alloys, and(110)[001]- and (110)[112]-oriented specimens of DS18-3 alloys, the flow stresses were similar at least up to strain level in this study, whereas the flow stresses were much lower for (100)[011]-, (100)[012]- and(210)[001]-oriented specimens in DS18-3 alloys. Such flow behavior is considered to be closely related to morphology of Ni_3Al precipitates and cross-slip within Ni matrix which was related to the operative slip systems.

Keywords: Ni/Ni3Al single crystals, plane strain compression, morphology of Ni3Al precipitates, cross-slip