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Effect of nickel addition in Al-Cu-Mg alloys: microstructural evaluation and mechanical strength

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Al-Cu-based alloys reveal specific and attractive properties for many automotive and aeronautical applications. Current design specifications for the manufacturing of components, from metal-matrix composites, require that aluminum alloys have known and stable properties, required to withstand the severe application conditions. In order to produce custom-tailored alloys, correlations between microstructural parameters and mechanical, and corrosion behavior are fundamental. Therefore, this work aims to develop an experimental analysis of the influence of Ni content on the microstructure arrangement and microhardness of an Al-5Cu-1.5Mg-1.0Ni alloy. The alloy was subjected to an upward directional solidification technique, which allowed a wide range of cooling rates to be obtained in a single experiment. Traditional techniques of metallography, optical microscopy and scanning electron microscopy (SEM) associated with energy-dispersive X-ray spectroscopy (EDS) were applied for microstructural characterization. Vickers microhardness test was carried out according to the ASTM E384. A microstructure composed essentially of dendrites was shown to characterize the Al-rich matrix along the entire casting. Intermetallic compounds containing Ni were observed in the eutectic mixture in the form of a ternary eutectic. It was observed that higher microhardness is associated with the interaction between the as-solidified samples having a refined Al-rich matrix (lower values of primary and secondary dendritic spacings) and a homogeneous distribution of intermetallic compounds consisting of Al, Cu, Mg, and Ni in the interdendritic regions. Acknowledgments: The authors acknowledge the financial support provided by CNPq (The Brazilian Research Council: grant 407871/2018-7) and the Brazilian Nanotechnology National Laboratory – LNNano for the use of its facilities.