The effect of the Mg content on the microstructure and mechanical properties of Al-xMg-2.0Si-0.6Mn alloy

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Abstract*:* Al-Mg alloys have good corrosion resistance and are suitable for manufacturing components used in complex marine environments, but their mechanical properties are poor, making them unsuitable for service loads under medium and high strength. In this study, the effect of Mg content on the microstructure and mechanical properties of the Al-xMg-2.0Si-0.6Mn alloy was investigated. The study aimed to investigate the optimal addition of Mg elements to improve the comprehensive performance of the alloy. The microstructure, phase composition and fracture morphology of the alloy were determined through OM, SEM, TEM and XRD analysis. With the increase of Mg content, the number of strengthening phases increases, which improves the comprehensive properties of the alloy. When the Mg content in an alloy exceeds 5%, the solubility of the Mg_2Si phase in the matrix is reduced, and the development of the coarse Mg_2Si phase limits the alloy's elongation. The performance is excellent when the content of Mg is 5%. The alloy has maximum tensile strength, yield strength, and elongation of 227.22 MPa, 136.55 MPa, and 7.24%, respectively. Furthermore, we discovered that the point-like Mg_2Si phase exists in the alloy and coexists with the point-like α-$Al_{15}(Fe, Mn)_3Si_2$. TEM investigation revealed the incoherent relationship between the two point-like phases, and the phase diagram suggested α-$Al_{15}(Fe, Mn)_3Si_2$ as a probable substrate for the nucleation of the Mg2Si phase.

Keywords*: Corrosion-resistant aluminum alloys; Mg_2Si phase; Mechanical properties; Microstructure*