

Microstructural characterization of quasicrystalline alloys of the Al-Fe-Nb system

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Aluminum alloys are very useful structural materials once they combine low density, high strength and good corrosion resistance. Due to their excellent specific properties, the use of these alloys in mobile structures, such as aircraft, light vehicles and armoured vehicles, is a critical point for the good performance of the vehicle. Recently, improvements in vehicle performance have imposed greater demands on the mechanical strength of Al alloys. The production of alloys by rapid solidification for special applications is characterized as one of the main alternatives for the processing of metallic materials, as it allows to obtain alloys with microstructures refined, metastable, nano and quasicrystalline and/or amorphous, with significant improvements in their properties when compared to commercial crystalline alloys solidified by conventional processes. The purpose of this work is to process and characterize alloys of the Al-Fe-Nb system obtained by rapid melt casting in copper shells. In the development of the study, three compositions were proposed: Al₉₀Fe₇Nb₃, Al_{95.5}Fe_{1.5}Nb₃ and Al₈₈Fe₇Nb₃Cr₂ (%at). The ingots were obtained by arc furnace and processed by rapid solidification in a "discovery plasma" furnace. The samples had the form of a stepped cylinder with a diameter variation of 2, 4 and 6 mm. After machining and preparation by metallography, the samples with varied diameters sections were characterized by microscopy techniques were characterized by techniques of microscopy, X-ray diffraction and Vickers hardness test. The results indicated that the cylindrical samples with varied diameter presented a refined structure containing the phases Al₃Nb and Al₃Fe in an Al-CFC matrix. In the hardness tests, the Al₉₀Fe₇Nb₃ alloy showed maximum values of 101, 64, 67 HV_{0,05} for the diameters of 2, 4 and 6 respectively. Similarly, Al_{95.5}Fe_{1.5}Nb₃ alloy presented maximum values of 63, 45, 49 HV_{0,05} and Al₈₈Fe₇Nb₃Cr₂ alloy showed maximum values 119, 103, 80 HV_{0,05}. In addition, there was an indication of quasicrystalline phase for the composition samples Al₉₀Fe₇Nb₃ and Al₈₈Fe₇Nb₃Cr₂, as verified in the SEM and XRD analyses.