Rapid Solidification of Nanocrystalline Alloy based on Cast Iron with Niobium and Boron Additions

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The amorphous structures were seen in Au–Si alloy in 1960s, for the first time. After this, other alloy compositions have been studied to understand glass-forming ability (GFA) and new processing routes to reach amorphous structures [1]. Amorphous and nanocrystalline Fe-based alloys present excellent properties, such as high hardness and wear resistance, with cooling rates of 10^3 to 10^6 K/s [2]. Thus, this study aims to obtain nanocrystalline or metastable structure through rapid solidification of ductile cast iron with B and Nb additions, resulting in composition $(Fe_{75}C_{10}Si_4)_{94-x}Nb_6B_x$ (x=5, 8, 12%at. B). The Fe-based alloy was processed through melt-spinning, the Discovery® Plasma furnace, copper mold casting and characterized by: DSC, XRD, SEM and Vickers microhardness. It was obtained: ribbons (40 µm thick) through melt-spinning, plates (1.0 and 2.0 mm) through copper mold casting process of $(Fe_{75}C_{10}Si_4)_{94-x}Nb_6B_x$ (%at.) alloy. The characterization showed amorphous ribbons, plates with crystalline phases: α-Fe, ɣ-Fe, NbC, Fe_2B and FeNbB, with high values of Vickers microhardness (HV_1) of 1252, 849 and 1381 HV to plate (1.0 mm thick) with 5, 8 and 12% at. Boro, respectively.

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