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Microstructure evolution and nitriding behaviors of Sm-Fe alloys in rapid solidification process

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Rapid solidification technology is used widely to fabricate micro-crystalline and amorphous alloys. In traditional nitriding process of coarse-grained Sm-Fe alloys, it is hard to further increase the nitrogen content and improve the uniform of nitrogen distribution. Therefore, the nitriding behaviors and microstructure evolution of rapidly-solidified Sm-Fe alloy ribbons fabricated in a rotating-quenching furnace were investigated in this work. Results indicate that with the rotating velocity of wheel increases, the cooling rate increases, the thickness of Sm-Fe alloy ribbon decreases and microstructural characteristics transform from coarse dendrites to cellular crystal, microcrystal, mixture of crystal and amorphous phase. Moreover, Sm and Fe elements in alloy ribbons tends to uniform compare with the as-cast alloys according to the laser ablation inductively coupled plasma mass spectrometry map. The size of all grains is still less than 10 μm although the crystalline grains grew during nitriding process of rapidly solidified Sm-Fe alloy at 420 °C. The smaller grain size and more grain boundaries in Sm-Fe alloy ribbons provide more locations for atomic nitrogen absorption in the nitriding process and improve the diffusion of nitrogen atoms. However, most penetrated nitrogen in Sm-Fe alloys are distributed on the boundaries of cellular grains in the forms of nitrogenous compounds. A quickly quenched Sm-Fe alloy ribbon with a stable near-stoichiometric Sm_2Fe_{17} phase and amorphous matrix in microstructure was fabricated successfully when the rotating velocity of wheel was greater than 34 m/s. After nitridation of quickly quenched Sm-Fe alloy ribbons, the constitutional phases are crystalline $Sm_2Fe_{17}N_x$ and α-Fe and amorphous nitrides. This phenomenon indicates that nitrogen atoms are distributed not only in crystalline phase but also in amorphous matrix. The nitrogen content in Sm-Fe alloy ribbons is up to 4.155%, which indicated the microstructure characteristics of quickly quenched Sm-Fe alloy is helpful for the improvement of nitrogen absorption.

Biography

Chunyan Song is a Lecturer of College of Metallurgy and Energy, North China University of Science and Technology. She has been working in the fields of special metallurgy and novel materials preparation. Her research on nitriding of alloys with crystal and amorphous phase provides new technologies for improving nitrogen absorption of Fe-based alloys. She has 16 invention patents and research publications in materials and metallurgy engineering journals. She is currently the major investigator of National Natural Science Foundation of China (51574104) and Natural Science Foundation-Steel and Iron Foundation of Hebei Province (E2014209213).

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