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稀土大块状非晶/纳米晶双相NdFeAl的制备与性能测量

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摘 要： 用铜模急冷法制得直径达8 mm的棒状稀土NdFeAl样品，X射线衍射、扫描电镜（SEM）和差热扫描（DSC）分析表明制备样品主要为大量非晶加少量纳米晶。测得起始晶化温度（T_x ）和熔点(T_m)分别为743 K和823 K，ΔT_m=80 K，T_{rx}=0.90。极小的ΔT_m 和高的T_{rx} 是具有良好非晶形成能力的主要原因。磁热重分析测量得到该非晶材料的居里温度点为525 K。通过控制大块状非晶样品的热处理工艺可得到不同纳米晶比例的非晶/纳米晶双相材料。振动样品磁强计测量结果表明，当晶相比例约为40%时，材料的硬磁性最差。

关键字： 急冷法； 非晶/纳米晶； 稀土； 磁性

Investigation on bulk rare-earth Nd-Fe-Al amorphous/nano-crystalline alloy

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Abstract: Cylindrical ingots of bulk amorphous $Nd_{70}Fe_{20}Al_{10}$ with a diameter of 8 mm were prepared by a copper mold casting method. It was proved that as-prepared samples are mainly consisted of amorphous phase by measurement of X-ray diffraction, observation of scanning electronic microscopy and analysis of differential scanning calorie. The onset crystallization temperature (T_x) and the melting temperature (T_m) of the samples were measured to be 743 K and 823 K, respectively. The temperature interval between $T_x$and T_m(ΔT_m) is as small as 80 K and the resulting reduced ratio of T_x/T_m is as high as 0.90. The extremely high T_x/T_m and the small ΔT_m values are assumed to be the reason for the achievement of the large glass-forming ability. The Curie temperature (T_c) of these samples was determined to be 525 K by magnto-thermal gravity analysis, which is higher than the highest T_c of binary Nd-Fe amorphous alloys. Dual phase alloys of different nano-

crystalline volume fraction were obtained by means of various annealing treatments to the as-prepared samples. The magnetic measurement indicated that the hard magnetic behaviour of the dual phase samples deteriorates most at the volume fraction about 40%, which has predicted in our previous theoretical computation.

Key words: solidification; rare-earth; amorphous/nano-crystalline alloy; magnetism