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Cu坯料纯度对$Cu_{46}Zr_{42}Al_7Gd_5$合金非晶形成能力与显微硬度的影响

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摘 要： 采用铜模吸铸法制备直径为3 mm的$Cu_{46}Zr_{42}Al_7Gd_5$块体非晶合金；研究Cu坯料纯度对该合金非晶形成能力、热稳定性和显微硬度的影响。结果表明：采用纯度较低的Cu坯料，分别以25%和50%的比例替代纯度较高的Cu坯料后，仍可制备直径为3 mm的非晶态合金；当替代比例提高到75%或更高时，合金呈现完全晶态相；当替代比例为25%时，合金的玻璃化转变温度为669 K，晶化温度为749 K，过冷液相区为80 K；当替代比例为50%时，合金的玻璃转化温度为684 K，晶化温度为751 K，过冷液相区为67 K；两种替代比例(25%和50%)的合金经573 K保温1 h热处理后，仍然保持非晶态结构；当替代比例为25%时，合金经673和773 K热处理后，合金由基体及弥散分布于其上的第二相组成，显微硬度明显提高；当替代比例为50%时，经673 K处理后，合金由基体及不均匀弥散分布于其上的第二相组成，显微硬度有所提高，而经773 K处理后，由第二相弥散分布于白色基体的白色区域和由细小白、灰两相混合组成的灰色区域组成，显微硬度大幅度提高。

关键字： $Cu_{46}Zr_{42}Al_7Gd_5$合金；块体非晶；晶化热处理；显微组织；显微硬度；纯度效应

Effect of copper billet purity on glass forming ability and microhardness of $Cu_{46}Zr_{42}Al_7Gd_5$ alloy

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Abstract: A bulk amorphous $Cu_{46}Zr_{42}Al_7Gd_5$ alloy with a diameter of 3 mm was prepared by copper mould sucking cast. The effect of copper billet purity on the glass forming ability, thermal stability and microhardness of the alloy was studied. The bulk amorphous $Cu_{46}Zr_{42}Al_7Gd_5$ alloy with a diameter of 3 mm can be prepared using copper billet with lower purity to replace copper billet with higher purity in the proportion of 25% and 50%, while the alloy shows the characteristic of crystalline in the proportion of 75% or above. When the copper billet with higher purity is replaced with lower purity billet in the proportion of 25%, the glass transition temperature is about 669 K, the crystallization temperature is about 749 K and

the supercooled region is about 80 K. When the copper billet with higher purity is replaced with lower purity billet in the proportion of 50%, the glass transition temperature is 684 K, crystallization temperature is 751 K and supercooled region is 67 K. The alloys all keep amorphous structure after heat treatment at 573 K for 1 h. The alloys in 25% proportion crystallize after heat treatment at 673 and 773 K for 1 h, which consist of substrate and second fine phase and have higher microhardness. The alloys in 50% proportion also consist of substrate and second fine phase, and have higher microhardness after heat treatment at 673 K for 1 h. There are two kinds of microstructures after heat treatment at 773 K for 1 h, white area consists of substrate and second fine phase, and grey area consists of white phase and grey phase. The microhardness increases sharply.

Key words: $Cu_{46}Zr_{42}Al_7Gd_5$ alloy; bulk amorphous alloy; crystallize heat treatment; microstructure; microhardness; purity effect

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