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研究论文

快淬纳米晶Mg2Ni型合金的气态和电化学贮氢动力学

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摘要： 用快淬技术制备了Mg2Ni1-xCux(x=0, 0.1, 0.2, 0.3, 0.4)合金，用XRD、SEM、HRTEM分析了铸态和快淬态合金的微观结构，测试了合金的气态贮氢动力学性能和电化学贮氢动力学。结果表明，所有快淬态合金均具有纳米晶结构，没有非晶相。Cu替代Ni不改变合金的主相Mg2Ni，而是使合金的晶粒显著细化。Cu替代Ni和快淬处理均显著地提高了合金的气态及电化学贮氢动力学性能。当淬速从0 m/s(铸态被定义为淬速0 m/s) 提高到30 m/s时，Mg2Ni0.8Cu0.2合金的5 min吸氢饱和率从56.7%增加到92.7%，20 min放氢率从14.9%增加到40.4%，高倍率放电能力从38.5%增加到75.5%，氢扩散系数从8.34×10^{-12} cm^2/s增加到3.74×10^{-11} cm^2/s。

关键词： 无机非金属材料 Mg2Ni型合金 快淬 Cu替代Ni 贮氢动力学

Gaseous and Electrochemical Hydrogen Storage Kinetics of As－Spun Nanocrystalline Mg2Ni1－xCux(x=0－0.4) Alloys

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Abstract: The Mg2Ni1−xCux (x=0, 0.1, 0.2, 0.3, 0.4) hydrogen storage alloys have been prepared by melt-spinning technology. The structures of the as-cast and spun alloys are characterized by XRD, SEM and TEM. The gaseous hydrogen absorption and desorption kinetics of the alloys were measured by an automatically controlled Sieverts apparatus. The electrochemical hydrogen storage kinetics of the as-spun alloys is tested by an automatic galvanostatic system. The results show that all the as-spun alloys hold an entire nanocrystalline structure and are free of amorphous phase. The substitution of Cu for Ni, instead of changing the major phase Mg2Ni, leads to a visible refinement of the grains of the as-cast alloys. Furthermore, both the melt spinning treatment and Cu substitution significantly improve the gaseous and electrochemical hydrogen storage kinetics of the alloys. As the spinning rate increases from 0 (As-cast is defined as spinning rate of 0 m/s) to 30m/s, the hydrogen absorption saturation ratio in 5 min, for the Mg2Ni0.8Cu0.2alloy, increases from 56.7 to 92.7%, the hydrogen desorption ratio in 20 min from 14.9
to 40.4%, the high rate discharge ability from 38.5 to 75.5%, the hydrogen diffusion coefficient from 8.34×10^{-12} cm^2/s to 3.74×10^{-11} cm^2/s.

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