Effects of $\text{Mo}_{0.46}\text{Fe}_{0.54}$ Alloy on Microstructure and Electrochemical Hydrogen Storage Performances of $\text{La}_{0.75}\text{Ce}_{0.25}\text{Ni}_{4.2}\text{Mn}_{0.9-x}\text{Cu}_{0.3}(\text{Mo}_{0.46}\text{Fe}_{0.54})_x$ ($x = 0-0.20$) Alloys

Jianliang Cao¹, Huanjian Xie¹, Zhihui Wen^{1,*}, Guohua Cao², Liqiang Ji³, Yanping Fan^{1,*},
Baoyong Liu¹

¹ School of Chemistry and Chemical Engineering, Henan Polytechnic University, Jiaozuo 454000, China

² School of Physics & Electronic Information Engineering, Henan Polytechnic University, Jiaozuo 454000, China

³ Inner Mongolia Rare Earth Ovonic Metal Hydride Co. Ltd., Baotou 014030, China

*E-mail: hpuforrest@hpu.edu.cn (Z. Wen); fanyanping@hpu.edu.cn (Y. Fan)

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The ratio of performance to price of $\text{La}_{0.7}\text{Ce}_{0.3}\text{Ni}_{4.2}\text{Mn}_{0.9}\text{Cu}_{0.3}$ hydrogen storage alloy was further optimized by substituting Mn with commercial $\text{Mo}_{0.46}\text{Fe}_{0.54}$ alloy, rather than pure Mo and Fe. Microstructures and electrochemical hydrogen storage properties of $\text{La}_{0.7}\text{Ce}_{0.3}\text{Ni}_{4.2}\text{Mn}_{0.9-x}\text{Cu}_{0.3}(\text{Mo}_{0.46}\text{Fe}_{0.54})_x$ ($x = 0-0.20$) alloys are investigated. X-ray diffraction and backscattered electron results indicate that the pristine alloy is LaNi_5 phase with a hexagonal CaCu_5 -type structure, while the alloys containing $\text{Mo}_{0.46}\text{Fe}_{0.54}$ consist of LaNi_5 matrix phase and a trace of Mo segregate phase. The lattice parameter a , c , c/a and V of LaNi_5 phase decrease after the addition of $\text{Mo}_{0.46}\text{Fe}_{0.54}$ alloy. As x increase from 0 to 0.20, maximum discharge capacity of alloy electrodes monotonically decreases from 332.5 ($x = 0$) to 310.2 ($x = 0.20$) mAh g^{-1} . The high-rate dischargeability the alloy electrodes at the discharge current density of 1200 mA g^{-1} first increases from 61.6% ($x = 0$) to 73.6% ($x = 0.10$), while further increasing the value of x jeopardizes HRD_{1200} . This is consistent with the variation tendency of hydrogen diffusion coefficient, which indicated that the electrochemical kinetic property is dominated by hydrogen atoms diffusion process in the bulk of alloy. The cycling capacity retention rate at the 100th charge/discharge cycle is decrease monotonously from 79.3 % ($x = 0$) to 62.6 % ($x = 0.20$) with increasing the content of $\text{Mo}_{0.46}\text{Fe}_{0.54}$ alloy, which should be ascribed to the deterioration of corrosion resistance of alloy electrode in the charging/discharging cycle.

Keywords: Hydrogen storage alloy; Electrochemical properties; Kinetics; Microstructure; MoFe alloy

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