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Mn和Ce对Fe-Ni-Mn-C-Si-Ce系合金组织和性能的影响

卢 铃, 朱定一, 汪才良

(福州大学 材料科学与工程学院, 福州350002)

摘 要:采用熔炼法制备出新型高耐磨的Fe-20Ni-xMn-3.5C-2.5Si系固体自润滑材料, 研究稀土元素Ce对Fe-20Ni-xMn-3.5C-2.5Si系合金中石墨的球化作用及Mn含量对力学性能及摩擦磨损性能的影响。结果表明: 随着Mn含量的增加, 合金凝固组织中奥氏体的硬度逐渐增大, 特别是Fe-20Ni-xMn-3.5C-2.5Si-0.75Ce系合金在摩擦过程中的表面硬度大幅度提高, 呈现出高锰钢特有的表面加工硬化性质, 通过TEM可以观察到磨损表面生成孪晶型马氏体; 添加0.75%(质量分数)的稀土Ce可以使结晶的石墨球化, 使抗拉强度和抗弯强度大幅度提高, 大约比未经球化处理的提高3-5.8倍; 稀土Ce的加入可以促进 $Fe_{1.1}Mn_{3.9}C_2$ 型碳化物的生成, 使材料的耐磨性进一步提高, 其中Fe-20Ni-16Mn-3.5C-2.5Si-0.75Ce合金的磨损率最低, 大约是QT500球墨铸铁的1/13。

关键字: Fe-Ni-Mn-C-Si-Ce合金; 高锰奥氏体; MnCe; 加工硬化; 摩擦; 磨损

Effects of Mn and Ce additions on structures and properties of Fe-Ni-Mn-C-Si-Ce alloys

LU Ling, ZHU Ding-yi, WANG Cai-liang

(College of Materials Science and Engineering, Fuzhou University, Fuzhou 350002, China)

Abstract: Fe-20Ni-xMn-3.5C-2.5Si solid self-lubricating materials with property of high-wearing were prepared by melting method. The spheroidization effect of rare earth Ce on graphite and the effect of Mn addition on mechanical properties and tribological performances of Fe-20Ni-xMn-3.5C-2.5Si alloys were studied. The results show that the austenite hardness of solidifying structures increases as the manganese content increases. The surface hardness of Fe-20Ni-xMn-3.5C-2.5Si-0.75Ce alloy increases widely after being worn and it appears the work-hardening of surface as like the high manganese-containing steel. The type of compound twin martensite on surface can be observed by TEM. The spheroidization effect of 0.75%(in mass fraction)of rare earth cerium on the graphite during crystallization is effective. The spheroidized alloy has higher tensile strength and flexural strength which is about 3-5.8 times higher than those of the non-spheroidized alloy. With

the addition of rare earth Ce, the second phase Fe_{1.1}Mn_{3.9}C₂, which makes the wear resisting property further increase, appears in matrix. Fe-20Ni-12Mn-3.5C-2.5Si-0.75Ce alloy has the lowest wear rate which is about 13 times lower than that of the spheroidal cast iron.

Key words: Fe-Ni-Mn-C-Si-Ce alloy; high manganese austenite; Mn; Ce; work-hardening; friction; wear

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地 址：湖南省长沙市岳麓山中南大学内 邮编： 410083

电 话： 0731-8876765, 8877197, 8830410 传真： 0731-8877197

电子邮箱： f-ysxb@mail.csu.edu.cn