

论文摘要

中国有色金属学报

ZHONGGUO YOUSEJINSHUXUEBAO XUEBAO

第17卷 第6期 (总第99期) 2007年6月

 [PDF全文下载]

文章编号: 1004-0609(2007)06-0927-07

Mg-2Nd合金的组织与力学性能

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摘要: 在铸钢坩锅中熔炼制备了Mg-2Nd二元镁合金, 试样经不同热处理工艺处理后, 测试合金的室温拉伸性能, 采用光学显微镜(OM)、扫描电镜(SEM)及透射电镜(TEM)观察合金的显微组织, 通过X射线衍射法(XRD)和能谱分析(XEDS)及选区电子衍射花样进行合金中的物相鉴别和微观成分分析。结果表明: Mg-2Nd合金的铸态组织由 α -Mg基体和呈离异共晶形貌的Mg₁₂Nd相组成; 热挤压后, Mg₁₂Nd相沿挤压方向呈纤维或颗粒状分布; 挤压过程中发生动态再结晶, 合金的抗拉强度(σ_b)由铸态的148.8 MPa提高到挤压态的210.2 MPa, 伸长率(δ)由铸态的2.8%提高到挤压态的19.9%; 热挤压和热轧成形的Mg-2Nd合金, 直接时效T5(extruded、rolled)处理能产生形变强化和时效硬化双重作用, 其中T5(rolled)态合金 σ_b 高达276.4 MPa, δ 较热轧态提高了64%; T5(rolled)态组织中出现了 β' 和 β 沉淀, 尺度均在50 nm左右, 对合金产生了明显的时效强化作用。

关键字: Mg-2Nd合金; 微观组织; 力学性能; 时效硬化; 形变强化

Microstructures and mechanical properties of Mg-2Nd alloy

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Abstract: The Mg-2Nd alloy was melted in a mild steel crucible. After heat treatment, the tensile properties of specimens were tested at room temperature, the microstructures were observed by using optical microscopy (OM), scanning electron microscopy (SEM) and transmission electron microscopy (TEM), and the microanalysis and characterization of second phase particles were carried out using X-ray diffraction (XRD), X-ray energy dispersive spectroscopy (XEDS) and selected area electron diffraction (SAED). The results show that the as-cast Mg-2Nd alloy consists of the α -Mg matrix and divorced eutectic phase Mg₁₂Nd. After hot extrusion the Mg₁₂Nd phase shows fibrous and granular morphology and is distributed along the extrusion direction. The dynamic recrystallization during hot extrusion significantly improves the tensile strength and elongation of alloys, which increase from 148.8 MPa and 2.8% to 210.2 MPa and 19.9%, respectively. For the extruded

and rolled Mg-2Nd alloys, the direct aging(T5) has the combined effect of work hardening and age hardening. The tensile strength of as rolled sample is raised to 276.4 MPa and the elongation is enhanced by 64% compared with that of extruded sample. After the direct aging(T5) treatment, the α -Mg matrix of hot rolled sample has β' and β precipitates with average sizes of 50 nm in length, which play important roles in age hardening.

Key words: Mg-2Nd alloys; microstructures; mechanical properties; age hardening; work hardening

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