

论文

含TRIP效应的Fe-18Mn-Si-C热轧TWIP钢的设计与研究

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摘要: 本文采用层错能估算和相图计算的方法, 通过增C降Mn的成分优选, 设计了 Fe-18Mn-0.528Si-0.6C(质量分数, %)实验钢, 研究表明, 该钢种在室温拉伸变形时会发生 $\gamma \rightarrow \epsilon$ 相变. 借助OM, XRD和TEM对热轧实验钢板室温拉伸性能测试前后的组织进行了分析与研究, 结果表明: 经过1100 °C开轧, 850 °C终轧后空冷的热轧钢板由于孪晶诱发塑性(TWIP)+相变诱发塑性(TRIP, $\gamma \rightarrow \epsilon$)双重效应的作用, 实现了抗拉强度超过1 GPa, 延伸率大于60%的优良性能, 达到了第三代汽车用钢的要求; 淬火 ϵ 马氏体和应力诱发 ϵ 马氏体的存在会导致力学性能下降.

关键词: 孪晶诱发塑性(TWIP)钢 ϵ 马氏体 层错能 材料设计 第三代汽车用钢

DESIGN AND INVESTIGATION ON THE HOT ROLLING TWIP STEEL WITH TRIP EFFECT

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Abstract: There exists obvious deficiency in traditional twining induced plasticity (TWIP) steel which exhibits excessive ductility but rather low strength. In order to improve the property, new composition of a test steel, *i.e.*, Fe-18Mn-0.528Si-0.6C (mass fraction, %) steel is designed through increasing C content and decreasing Mn content upon the estimation result of stack fault energy and phase diagram calculation. That the $\gamma \rightarrow \epsilon$ transformation may happen during deformation at room temperature in the designed steel is predicted through calculation. The microstructure, before and after tensile test, of the hot rolling test steel is analyzed with OM, XRD and TEM. It is shown that there occurs simultaneously TWIP and transformation induced plasticity (TRIP) effect in the steel treated by a special hot rolling process (rolling starting temperature 1100 °C, finishing rolling temperature 850 °C and air cooling) and superior mechanical property with strength higher than 1 GPa and elongation rate higher than 60% are then obtained which fit very well with the requirement of the third generation automobile steel. It is also revealed the existence of ϵ martensite obtained through quenching or induced by stress would damage the mechanical property.

Keywords: twining induced plasticity (TWIP) steel ϵ martensite stack fault energy material designing 3th generation auto steel

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