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论文

GH738高温合金热变形过程显微组织控制与预测 I. 组织演化模型的构建

姚志浩,董建新,张麦仓

北京科技大学材料科学与工程学院, 北京 100083

摘要： 采用Gleeble-1500热模拟机对GH738镍基高温合金进行了高温热压缩变形实验, 分析了该合金在初始晶粒不同的情况下, 变形温度1000-1160 ℃,应变速率0.01-10 s^{-1}, 工程变形量15%-70%条件下流变应力的变化规律及晶粒组织演化规律; 同时研究了变形温度1040-1120 ℃,应变速率0.1-10 s^{-1}, 变形量15%-50%、保温时间0-45 s条件下该合金的亚动态(静态)再结晶及保温温度980-1140 ℃, 保温时间0-4 h条件下的晶粒长大行为. 通过系统的物理热模拟实验, 构建了GH738高温合金在热变形过程中的晶粒组织演化模型及应力--应变模型, 所建立的GH738高温合金模型与实验结果相比均表现出较高的相关度.

关键词： GH738镍基变形高温合金 热变形 再结晶行为 组织演变 模型

MICROSTRUCTURE CONTROL AND PREDICTION OF GH738 SUPERALLOY DURING HOT DEFORMATION I. Construction of Microstructure Evolution Model

YAO Zhihao, DONG Jianxin, ZHANG Maicang

School of Materials Science and Engineering, University of Science and Technology Beijing, Beijing 100083

Abstract: The hot deformation behavior of GH738 superalloy with different initial grain sizes was studied using hot compression experiments via Gleeble－1500. Correlations between flow stress, process parameters and microstructure evolution were characterized in the temperature range of 1000—1160 ℃, strain rate range of 0.01—10 s^{-1} and engineering strain range of 15%—70%. Besides, metadynamic recrystallization and static recrystallization were studied in the temperature range of 1040—1120 ℃, strain rate range of 0.1—10 s^{-1} and engineering strain range of 15%—50% with soaking time for 0—45 s; grain growth behavior was researched in the temperature range 980—1140 with soaking time for 0—4 h. The results show that recrystallization behavior of GH738 superalloy was significantly affected by initial grain size, deformation temperature, strain and strain rate. Thermomechanical behavior and microstructural evolution models were systematically constructed based on the investigation of dynamic recrystallization, meta－dynamic recrystallization, static recrystallization and grain growth. The analyses indicate that these models shows a high correlation with actual results of GH738 superalloy.

Keywords: GH738 wrought nickel base superalloy hot deformation recrystallization behavior crostructure evolution model

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通讯作者: 董建新

作者简介: 姚志浩, 男, 满族, 1982年生, 博士生

通讯作者E-mail: zhihao-yao@163.com

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