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论文

316L不锈钢热加工硬化行为及机制

宋仁伯[1)],项建英[1)],侯东坡[1)],任培东[2)]

1. 北京科技大学材料科学与工程学院, 北京 100083 2. 酒泉钢铁股份有限公司技术中心, 嘉峪关 735100

摘要:

在Gleeble-1500热模拟试验机上, 通过高温压缩实验对316L不锈钢的热加工硬化特点和机制进行了研究. 根据Ludwik幂函数模型对实验数据进行了非线性拟合, 并用 Crussard-Jaoul分析法计算了Ludwik幂函数模型的*n*值. 实验结果表明: 316L不锈钢在热变形过程中易发生加工硬化, 真应力-应变曲线上未出现应力峰值; 热变形过程中发生了部分动态再结晶, 这一不完全的软化机制无法抵消热加工硬化的作用, 另外在热变形过程中发生了孪生行为, 这是热加工硬化的主要机制之一.

关键词: 316L不锈钢 热加工硬化 Crussard-Jaoul分析法 动态再结晶 孪晶

BEHAVIOR AND MECHANISM OF HOT WORK-HARDENING FOR 316L STAINLESS STEEL

SONG Renbo[1)], XIANG Jianying[1)], HOU Dongpo[1)], REN Peidong[2)]

1 School of Materials Science and Engineering, University of Science and Technology Beijing, Beijing 100083 2 Technological Center of Jiuquan Iron $\&$ Steel Co. Ltd., Jiayuguan 735100

Abstract:

The characteristics of hot work-hardening for 316L stainless steel have been systematically studied through high temperature compression tests on the Gleeble-1500 thermal simulation testing machine. According to Ludwik true stress-strain model, the experimental data has been regressed by using nonlinear fitting method, and the n value in Ludwik model, a comprehensive index which reflects the competitive result between work-hardening and softening, has been calculated with Crussard-Jaoul method. The dynamic recrystallization and twinning were observed by OM and TEM. The experiments reveal that 316L stainless steel is easy to work-hardening during hot deformation, and deformation rate can effect n^{C-J}-ε curves and variation law; There is no peak stress on its true stress-strain curves, but partial dynamic recrystallization has occurred during hot working process. This incomplete softening mechanism can't counteract the effect of hot work-hardening, so the true stress-strain curves still rise with deformation increasing; In addition, twinning occurred during hot working is one of the major mechanisms of hot work-hardening.

Keywords: 316L stainless steel hot work-hardening Crussard-Jaoul analysis dynamic recrystallization twin

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通讯作者: 宋仁伯

作者简介: 宋仁伯, 男, 1970年生, 副教授, 博士

作者Email: songrb@mater.ustb.edu.cn

参考文献:

[1] ASM, translated by Ma J R, Chen L M. Metals Handbook. Beijing: Machinery Industry Press, 1994: 7 (ASM, 马九荣, 陈立敏译. 金属手册. 北京: 机械工业出版社, 1994: 7)

[2] Wang S T, Yang K, Shan Y Y, Li L F. Acta Metall Sin, 2007; 43: 171 (王松涛, 杨柯, 单以银, 李来风. 金属学报, 2007; 43: 171)

[3] Soussan A, Degallaix S. Mater Sci Eng, 1991; A142: 169

[4] Ludwigson D C, Berger J A. JISI, 1969; 207: 63

[5] Simmons J W. Acta Mater, 1997; 45: 2467
[6] Lan S H, Lee H J, Lee S H. Mater Des, 2009; 30: 3881
[7] Jha B K, Ram A, Sagar D V. J Mater Sci Lett, 1987; 6: 891
[8] Mejia I, Maldonado C, Benito J A. Mater Sci Forum, 2006; 509: 37
[9] Remy L. Metall Trans, 1981; 12A: 387
[10] Karaman I, Sehitoglu H, Maier H J. Acta Mater, 2001; 49: 3919
[11] Poliak E I, Jonas J J. ISIJ Int, 2003; 43: 684
[12] McQueen H J, Yue S, Ryan N D, Fry E. J Mater Process Technol, 1995; 53: 293
[13] Adler P H, Olson G B, Owen W S. Metall Trans, 1985; 17A: 1725

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