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论文

2205双相不锈钢的高温变形行为

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摘要：

利用Gleeble-3800热力模拟试验机在温度为1223-1523 K, 应变速率为0.01-10 s^{-1}的条件下进行了2205双相不锈钢热压缩变形实验, 测定了真应力-真应变曲线, 分析了变形组织. 结果表明: 奥氏体分布在随温度升高而含量增加的铁素体基体上, 升高温度和降低应变速率可促进奥氏体发生动态再结晶. 基于热变形方程计算得到了热变形激活能Q=451 kJ/mol, 表观应力指数n=4.026. 真应力-真应变曲线存在的“类屈服平台”效应与Z参数有关, 随着Z参数的减小而逐渐增强. 基于简化应力函数的ln Z与σ_p之间的线性关系在临界点(ln Z_c=38.18)发生偏移；峰值应力与温度及应变速率的关系可表示为: σ_p=20.6lnε+1118002/T-266.8(ln Z>38.18); σ_p=9.1lnε+493874/T-701.9(ln Z≦38.18)

关键词： 双相不锈钢 热变形 动态再结晶 Z参数 峰值应力

HOT DEFORMATION BEHAVIOR OF 2205 DUPLEX STAINLESS STEEL

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Abstract:

During hot deformation of the duplex stainless steels consisting of δ--ferrite and γ--austenite, their microstructure evolution and mechanical response are more complicated as compared with those of single--phase ferritic or austenitic stainless steels, especially for study of the mechanical behavior. In the present research, the hot deformation behavior of a 2205 duplex stainless steel has been investigated through uniaxial compression test using Gleeble--3800 thermal--mechanical simulator within the temperature range of 1223---1523 K and the strain rate range of 0.01---10 s^{-1}, the corresponding flow curves and their characters and microstructures have been determined and analyzed. Elongated austenite distributes in ferrite matrix, and the volume fraction of ferrite increases with rising temperature. Dynamic recrystallization of austenite is enhanced by increasing temperature and decreasing strain rate. Based on the constitutive equation for hot deformation, the apparent activation energy (Q) and the apparent stress exponent (n) of the steel are obtained to be about 451 kJ/mol and 4.026, respectively. There is a particular shape of flow curves, *i.e.* a yield point elongation-like effect, which is characterized by a non-strengthening plateau during the initial stages of plastic deformation. This yield point elongation-like effect increases with decreasing Zener-Hollomon parameter, Z. When used a simplified stress function, a deviation of linear relationship between ln Z and peak stress (σ_p) occurred at the critical value (ln Z_c=38.18). Relationships between peak stress and temperature and strain rate can be more simply described as σ_p=20.6ln ε+1118002/T-266.8(ln Z>38.18), and σ_p=9.1ln ε+493874/T-701.9(ln Z≦38.18).

Keywords: duplex stainless steel hot deformation dynamic recrystallization Z parameter peak stress

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参考文献：

[1] Nilsson J O. Mater Sci Technol, 1992; 8: 685

[2] Chen T H, Weng K L, Yang J R. Mater Sci Eng, 2002; A338: 259
[3] Tseng C M, Liou H Y, Tsai W T. Mater Sci Eng, 2003; A344: 190
[4] Yu Z C, Cheng S M, Ding D H. Spec Steel Technol, 2005; (4): 42
(余志川, 程士明, 丁大虎. 特钢技术, 2005; (4): 42)

[5] Shu X J, Zhang S Q, Song Z G. Steel Pipe, 2004; 33(6): 15
(舒先进, 张淑琴, 宋志刚. 钢管, 2004; 33(6): 15)

[6] Iza–Mendia A, Pi˜nol–Juez A, Urcola J J, Guti´errez I. Metall Mater Trans, 1998; 29A: 2975
[7] Pi˜nol–Juez A, Iza–Mendia A, Guti´errez I. Metall Mater Trans, 2000; 31A: 1671
[8] Balacin O, HoffmannWA, Jonas J J. Metall Mater Trans, 2000; 31A: 1353
[9] Evangelista E, McQueen H J, Niewczas M, Cabibbo M. Can Metall Q, 2004; 43: 339
[10] Cabrera J M, Mateo A, Llanes L, Prado J M, Anglada M. J Mater Process Technol, 2003; 143–144: 321
[11] Reis G S, Jorge A M, Balancin O. Mater Res, 2000; 3: 31
[12] Cizek P, Wynne B P. Mater Sci Eng, 1997; A230: 88
[13] Dehghan–Manshadi A, Barnett M R, Hodgson P D. Mater Sci Technol, 2007; 23: 1478
[14] Dehghan–Manshadi A, Hodgson P D. J Mater Sci, 2008; 43: 6272
[15] Duprez L, de Cooman B C, Akdut N. Metall Mater Trans, 2002; 33A: 1931
[16] Jinmenze J A, Carreno F, Ruano O A. Mater Sci Technol, 1999; 15: 127
[17] Hernandez L E, Beynon J H, Christophe P, Sybrand Z. Steel Res Int, 2005; 76: 137
[18] Imbert C, Ryan N D, McQueen H J. Metall Mater Trans, 1984; 15A: 1855
[19] Milovic C, Manojlovic D. Andjelic M, Drobnjak D. Steel Res, 1992; 63: 78
[20] Wang B Z, Fu W T, Lv Z Q, Jiang P, Zhang W H, Tian Y J. Mater Sci Eng, 2008; A487: 108

本刊中的类似文章

1．孙本荣;曾秀珍.热连轧含Nb低碳钢板卷奥氏体再结晶研究[J]. 金属学报, 1988,24(2): 176-182

2．高飞;徐有容.Cr25Ti铁素体钢转动形核的动态再结晶机制[J]. 金属学报, 1988,24(3): 261-266

3．赵朴;陆世英.18-5-Nb双相不锈钢的形变组织及耐局部腐蚀性能[J]. 金属学报, 1988,24(6): 482-486

4．何建宏;唐祥云;陈南平.氢在(α+γ)双相不锈钢中的扩散[J]. 金属学报, 1989,25(1): 42-47

5．何建宏;唐祥云;陈南平.铁素体-奥氏体双相不锈钢的氢致开裂研究[J]. 金属学报, 1989,25(1): 37-41

6．姚可夫;唐迺泳;陈南平.双相不锈钢中裂纹尖端塑性变形行为的透射电镜原位观察[J]. 金属学报, 1989,25(3): 57-62

7．赵嘉蓉;杨节.55SiMnVB钢高温高速变形的流动应力研究[J]. 金属学报, 1989,25(5): 119-123

8．何建宏;唐祥云;陈南平.晶粒大小对双相不锈钢的强度和氢致开裂的影响[J]. 金属学报, 1990,26(4): 27-31

9．姚可夫;唐迺泳;陈南平.双相不锈钢中奥氏体相内裂纹扩展路径的透射电镜原位观察[J]. 金属学报, 1991,27(2): 20-26

10．徐有容;顾清;王德英;顾菊芳;瞿天才.高Mo奥氏体不锈钢动态变形力学行为研究[J]. 金属学报, 1991,27(4): 134-138