

论文

非比例加载下Zr-4合金的宏观响应及其微观机理

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摘要: 研究了Zr-4合金在双向拉-拉复合加载过程中,沿不同非比例加载路径下,材料塑性变形行为及其微观机理结果表明,加载路径的突然变化,引起应力矢量较应变增量矢量滞后.宏观应力响应表现为瞬时软化,随后重新强化特征,变形软化和重新强化的程度及其变化率与转折角大小及转折方向有关.电镜观察表明,单调折线加载后形成两组平行的位错线;有约束单轴循环变形后形成了平行的位错线;双三角形路径下,在平行的位错墙内部形成了许多位错线;椭圆和圆形路径下有形成位错胞的趋势.

关键词: Zr-4合金 复合加载 本构方程 微观机理 位错组态

MACROSCOPIC RESPONSE AND MICROSCOPIC MECHANISM OF ZIRCALOY-4 UNDER NONPROPORTIONAL LOADING

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Abstract: Monotonic and cyclic plastic deformation behaviour and microscopic mechanism of zircaloy-4 under biaxial tension loading along different loading paths were investigated. The results show that an obvious stress delay appears in comparison with the strain increment vector after the turning point of a strain path. The equivalent stress suddenly drops then increases, and the firstly softening and subsequently hardening degrees are related to the turning angle values, the path length and turning direction. Therefore, the influence of the deformation history and the coupled effects among strain components on the response can not be neglected. By TEM, the deformed dislocation configurations are parallel dislocation lines in uniaxial tension with constraint condition, a lot of free dislocation lines between channels in double-triangle, and embryonic cells in elliptical and circular loading, respectively. The correlation between macroscopic deformation behaviour and microscopic deformation structure is discussed, finally.

Keywords: zircaloy-4 nonproportional loading constitutive equation microscopic mechanism dislocation structure

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参考文献:

- 1 著,吕允文,高绣雯译核工程材料北京:原子能出版社,1987write, Lu Yunwen, Gao Xiuwen translate. Materials in NuclearEngineering. Beijing: Atom Publisher, 1987)
- 2肖林.复合加载下材料塑性变形行为及其微观机理西安交通大学博士后研究报告,1996(Xiao Lin. Plastic Deformation Behavior and Mcroscopic Mechanism of Materials Under Combined Loading. Postdoctor Thesis, Xi'an Jiaotong University, 1996)
- 3 Valanis K C. Arch Mech, 1980; 32:171
- 4 Xiao Lin, Kuang Zhenbang. Acta Maten 1996; 44: 3059
- 5 Doong S H, Socie D F, Robertson I M. ASME J Eng Mater Technol, 1990; 112: 456
- 6 McDowell D L. J Mech Phys Solids, 1985; 33: 559
- 7 Doong S H, Socie D F. ASME i Eny Mater Technol, 1991; 113: 23
- 8 肖林. 中国铝业,1997; 21: 30(Xiao Lin. Chin Molybdenum Ind, 1997; 21: 30)

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9 Xiao Lin, Gu Haicheng, Kuang Zhenbang. Acta Metall Sin (Engl Lett), 1995; 8: 219

10 Xiso Lin, Gu Haicheng. Scr Metall Mater, 1994; 30: 175

11 Xiso Lin, Gu Haicheng. Metall Mater Trans, 1997; 28A: 1021

12 Miura S, Umeda K. Scr Metall, 1973; 7: 337

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1. 肖林, 宋凯, 顾海澄. Zr-4双轴低周疲劳寿命估算[J]. 金属学报, 1999,35(4): 397-402
2. 丁向东, 王瑞红, 刘刚. 双轴比例加载条件下含氢化物Zr-4合金变形行为的数值分析[J]. 金属学报, 2003,39(9): 967-973
3. 肖林, 白菊丽. Zr-4合金双轴疲劳行为及其微观变形机理 I. 双轴疲劳变形行为[J]. 金属学报, 2000,36(9): 913-918
4. 王航, 丁向东, 肖林. 非比例加载下冷变形Zr-4合金的宏观应力响应及其位错亚结构[J]. 金属学报, 2006,42(3): 251-258
5. 王航, 丁向东, 肖林, 孙军. 双轴加载下冷变形Zr-4合金的循环变形行为及其微观机理[J]. 金属学报, 2005,41(5): 517-522
6. 肖林;顾海澄.Zr及Zr-4合金的循环耗散能、分形维数与疲劳寿命的关系[J]. 金属学报, 1998,34(7): 705-712