

## 研究论文

### NiAl-28Cr-5.94Mo-0.05Hf-0.01Ho定向共晶合金的高温氧化行为

王振生<sup>1,2</sup>, 周兰章<sup>2</sup>, 郭建亭<sup>2</sup>, 梁永纯<sup>2</sup>, 胡壮麒<sup>2</sup>

1.湖南科技大学 机电工程学院 湘潭 411201

2.中国科学院金属研究所 沈阳 110016

**摘要:** 在900--1150℃氧化的NiAl-28Cr-5.94Mo-0.05Hf-0.01Ho定向共晶合金,在其表面生成了连续的Al<sub>2</sub>O<sub>3</sub>氧化膜,具有良好的抗氧化性能。定向凝固工艺使合金的组织细化并提高了Cr(Mo)相中Al元素的含量,以及加入微量稀土元素Ho,都有利于生成Al<sub>2</sub>O<sub>3</sub>氧化膜。在NiAl-28Cr-5.94Mo-0.05Hf-0.01Ho定向共晶合金的氧化过程中表面氧化膜发生相变 $\theta$ -Al<sub>2</sub>O<sub>3</sub>→ $\alpha$ -Al<sub>2</sub>O<sub>3</sub>,导致其1000℃氧化质量增加出现反常。

**关键词:** 金属材料 金属间化合物 NiAl 高温氧化 定向共晶合金

### High Temperature Oxidation Behavior of Directional Solidification NiAl-28Cr-5.94Mo-0.05Hf-0.01Ho Eutectic Alloy

WANG Zhensheng<sup>1,2</sup>, ZHOU Lanzhang<sup>2</sup>, GUO Jianting<sup>2</sup>, LIANG Yongchun<sup>2</sup>, HU Zhuangqi<sup>2</sup>

1.School of Electromechanical Engineering, Hunan University of Science and Technology, Xiangtan 411201

2.Institute of Metal Research, Chinese Academy of Sciences, Shenyang 110016

**Abstract:** The isothermal oxidation behavior of NiAl-28Cr-5.94Mo-0.05Hf-0.01Ho directional eutectic alloy in the temperature range of 900-1150 °C was investigated. The results revealed that a continuous Al<sub>2</sub>O<sub>3</sub> scale was formed and owned excellent oxidation resistance. Trace rare earth element Ho distributed uniformly at the alloy, together with refining structure and relatively high content of Al of Cr (Mo) phase by directional solidification (DS) process are beneficial to the formation of continuous Al<sub>2</sub>O<sub>3</sub> coatings. During the oxidation of NiAl-28Cr-5.94Mo-0.05Hf-0.01Ho directional eutectic alloy, a phase transformation from  $\theta$ -Al<sub>2</sub>O<sub>3</sub> to  $\alpha$ -Al<sub>2</sub>O<sub>3</sub> was found on the surface of oxidation film, and it resulted in the abnormal oxidation mass gaining when the alloy oxidized at 1000°C.

**Keywords:** metallic materials intermetallic compounds NiAl high temperature oxidation directional eutectic alloy

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作者简介:

通讯作者E-mail: jtguo@imr.ac.cn

## 参考文献:

- [1] Guha S, Monroe P R, Baker I, Room temperature deformation behavior of multiphase Ni-20at.%Al-30at.%Fe and its constituent phases, Mater. Sci. Eng., 131A, 27(1991)
- [2] K.S.Kumar, R.Darolia, D.F.Lahrman, S.K.Mannan, Tensile creep response of an NiAl-TiB<sub>2</sub> particulate composite, Scr. Metall. Mater, 26, 1001(1992) 
- [3] R.Darolia, W. S. Walston, Effect of specimen surface preparation on room temperature tensile ductility of an Fe-containing NiAl single crystal alloy, Intermetallics, 4, 505 (1996) 

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- [4] Johnson D.R., Chen X.F., Oliver B.F., Noebe R.D., Whittenberger J.D, Processing and mechanical properties of in-situ composites from the NiAl-Cr and the NiAl-(Cr, Mo) eutectic systems, *Intermetallics*, 3, 99(1995) [crossref](#)
- [5] CUI Chuanyong, GUO Jianting, Investigation on microstructure and elevated temperature mechanical property of NiAl-28Cr-5Mo-1Hf alloy, *Acta Metall Sin*, 35(5), 477 (1999)  
(崔传勇, 郭建亭, NiAl--28Cr--5Mo--1Hf多相金属间化合物的显微组织及力学性能研究, *金属学报*, 35(5), 477(1999))
- [6] CUI Chuanyong, GUO Jianting, LI Gusong, QI Yihui YE Henqiang, Study on microstructure and elevated temperature mechanical property of directionally solidified NiAl alloy II. elevated temperature mechanical property and interface, *Acta Metall Sin*, 36(11), 1144 (2000)  
(崔传勇, 郭建亭, 李谷松, 齐义辉, 叶恒强, 定向凝固NiAl合金的微观组织和高温力学性能 II.高温力学性能和界面, *金属学报*, 36(11), 1144(2000))
- [7] XU Chunmei, GUO Jianting, YANG Fubao, High temperature oxidation on behavior of NiAl-28Cr-5Mo-1Hf alloy, *Acta Metall Sin*, 37(8), 857(2001)  
(徐春梅, 郭建亭, 杨福宝, NiAl--28Cr--5Mo--1Hf合金的高温氧化行为研究, *金属学报*, 37(8), 857(2001))
- [8] ZHANG Shizhen, GUO Jianting, REN Weili, ZHOU Wenlong, Effects of rare earth elements on high temperature oxidation resistance of NiAl v CrMo(Hf) alloy, *Journal of Chinese Society for Corrosion and Protection*, 25(2), 100(2005)  
(张仕臻, 郭建亭, 任维丽, 周文龙, 稀土元素对NiAl / CrMo(Hf)共晶合金氧化性能影响, *中国腐蚀与防护学报*, 25(2), 100(2005))
- [9] Zhang Guangye, Effect of Rare-Earth-Elements on The Microstructure and Mechanical and Chemical Properties of NiAl-Based Eutectic Alloy, shenyang: Institute of Metal Research Chinese Academy of Science, (2004).  
(张光业, 稀土元素对NiAl基共晶合金的组织 and 性能影响的研究, 博士学位论文, 中国科学院金属研究所, (2004))
- [10] ZHANG Guangye, ZHANG Hua, WANG Zhensheng, GUO Jianting, ZHOU Lanzhang, Oxidation Behavior of NiAl-30.9Cr-3Mo-0.1Dy Alloy at High Temperature, *Rare Metal Materials and engineering*, 35(5), 719(2006)  
(张光业, 张华, 王振生, 郭建亭, 周兰章, NiAl--30.9Cr--3Mo--0.1Dy合金的高温氧化行为, *稀有金属材料与工程*, 35(5), 719(2006))
- [11] GUO Jianting, Ordered intermetallic compound NiAl alloy, (Beijing, Science Press, 2003) p.80  
(郭建亭, 有序金属间化合物镍铝合金, (北京, 科学出版社, 2003) p.80))
- [12] SHENG Liyuan, Effects of Ho alloying addition, rapid solidification and strong magnetic field treatment on the microstructures and mechanical properties of NiAl-based eutectic alloys, shenyang: Institute of Metal Research Chinese Academy of Science, (2009)  
(盛立远, Ho合金化、快凝工艺及强磁场处理对NiAl基共晶合金组织和性能的影响, 博士学位论文, 中国科学院金属研究所, (2009))
- [13] XU chunmei, Investigation on the directionally solidified microstructure and mechanical and high temperature oxidation properties of NiAl-Based Eutectic Alloy, shenyang: Institute of Metal Research Chinese Academy of Science, (2003).  
(徐春梅, NiAl基共晶合金的定向凝固组织、力学性能及高温氧化研究, 博士学位论文, 中国科学院金属研究所, (2003))
- [14] LAI Wanhui, WANG Shuhe, SUN Chao, TAN Minghui, LI Hui, GUO Jianting, Corrosion science and protection technique, 5(3), 213(1993)  
(赖万慧, 王淑荷, 孙超, 谭明晖, 李辉, 郭建亭, 三种NiAl基合金的抗氧化性能, *腐蚀科学与防护技术*, 5(3), 213(1993))

#### 本刊中的类似文章

1. 李谷松; 丁炳哲; 苗卫方; 叶荔蕾; 郭建亭. 用机械合金化方法制备Ni-Al系金属间化合物[J]. *材料研究学报*, 1994, 30(14): 91-96
2. 唐兆麟; 王福会; 吴维. 微晶化对TiAl抗高温氧化性能的影响[J]. *材料研究学报*, 1998, 12(2): 183-186
3. 唐兆麟; 王福会; 吴维. 反应溅射Al<sub>2</sub>O<sub>3</sub>膜对TiAl抗高温氧化性能的影响[J]. *材料研究学报*, 1997, 11(5): 507-510
4. 程天一. 富Ni的NiAl退火组织和室温力学性能[J]. *材料研究学报*, 1995, 9(5): 406-408
5. 邢占平; 郭建亭; 戴吉岩; 安阁英; 胡壮麒. 内生TiC颗粒增强NiAl基复合材料的初步研究[J]. *材料研究学报*, 1995, 9(2): 190-192
6. 曾潮流; 吴维旻; 郭建亭. 渗铝NiAl-20%Fe金属间合金的高温热腐蚀[J]. *材料研究学报*, 1996, 32(2): 197-201
7. 唐兆麟; 王福会; 吴维. Cr对TiAl金属间化合物高温氧化性能的影响[J]. *材料研究学报*, 1997, 33(10): 1028-

8. 李向阳;张永刚;陈昌麒;张孝吉;张通和;张荟星.二元Ti-Al合金高温氧化机理[J]. 材料研究学报, 1997,33(9): 964-970
  9. 唐兆麟;王福会;吴维 .TiAlCr涂层对TiAl金属间化合物抗高温氧化性能的影响[J]. 材料研究学报, 1998,18(1): 35-40
  10. 陈俊明;徐颂波.Ni<sub>3</sub>Al(B)系金属间化合物在LiCl-KCl熔盐中的腐蚀电化学行为[J]. 材料研究学报, 1995,15(3): 167-172
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