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表面与界面工程

离子注钇对镍表面氧化膜微观结构与性能的影响

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摘要

对纯镍及其表面离子注钇样品在1000℃空气中的恒温氧化和循环氧化行为进行了研究。用扫描电镜和透射电镜对表面氧化膜的微观形貌进行了观测。用声发射方法对氧化膜在氧化和空冷阶段的开裂信号进行了实时监测。用激光拉曼谱对含钇和不含钇氧化膜的内应力水平进行了测量。结果表明，离子注钇显著提高了镍的抗氧化性能，其原因是钇降低了Ni0氧化膜的生长速率、细化了氧化物晶粒，使氧化膜具有更好的高温塑性及释放膜内应力的能力。此外，离子注钇还减少了氧化膜/基体界面缺陷的数量及大小，因而显著改善了氧化膜在镍基体上的黏附性和保护性。

关键词 氧化 离子注入 激光拉曼谱 应力 钇

分类号

Influence of yttrium-implantation on micro-structure and adhesive property of oxide film formed on nickel

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Abstract

Isothermal oxidation and cyclic oxidation behavior of pure and yttrium-implanted nickel was studied at 1000℃ in air.Scanning electronic microscopy（SEM）and transmission electronic microscopy（TEM）were used to examine the morphology and structure of oxide films formed on nickel.It was found that yttrium-implantation greatly improved the anti-oxidation ability of nickel.Acoustic emission（AE）technique was used in situ to monitor the cracking of oxide films in oxidizing and air-cooling stages.Laser Raman spectrometer was also used to study the stress status of oxide scales formed on nickel with and without yttrium.The main reason for the improvement of anti-oxidation of nickel was that yttrium-implantation greatly reduced the growing speed and grain size of NiO，and this fine-grained NiO oxide film might have better high temperature plasticity and could relieve part of compressive stress by means of creeping.In the meantime，yttrium-implantation reduced the size and number of interfacial defects，hence remarkably enhancing the adhesion of protective NiO oxide scale formed on nickel substrate.

Key words

oxidation ion-implantation laser Raman stress yttrium

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