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交流阻抗谱法在热障涂层失效研究中的应用

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Failure Evaluation of Thermal Barrier Coatings by Impedance Spectroscopy

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摘要

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摘要 介绍了交流阻抗谱法作为无损检测方法在热障涂层失效分析中的应用。通过对热循环、静态氧化过程中热障涂层体系的阻抗谱分析,利用交流阻抗谱对热障涂层进行拟合,得到了服役过程中 D_M 以及TGO电阻 R 拟合的结果与氧化时间呈抛物线关系;并根据阻抗的变化确定了粘结层的氧化过程中氧化物成分从 Al_2O_3 变化到混合氧化物的过程;对陶瓷层电阻的拟合结果表明,陶瓷层在热循环250~350次之间的电阻变化与陶瓷层内微观结构以及应力的变化有关。

关键词: 热障涂层 无损检测 交流阻抗 失效分析

Abstract: The application of AC Impedance Spectroscopy (IS) as a non-destructive method on failure evaluation of Thermal Barrier Coatings (TBCs) is introduced. The growth and change of composition of TGO, and the change of microstructure of top coat as function of thermal cyclic test and isothermal test time are investigated by AC IS. It is found that the fitted diameter of modulus and resistance of TGO show parabola relationship with oxidation time. The composition variation of TGO from Al_2O_3 to mixed oxidation can be monitored by analysis IS measured during bond coat oxidation. The resistance of YSZ layer fitted from IS shows that the value skipping from 250 to 350 cycles is caused by microstructure and residual stress in ceramic layer.

Keywords: thermal barrier coatings non-destructive evaluation impedance spectroscopy failure analysis

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