

### 论文摘要

中国有色金属学报

ZHONGGUO YOUSEJINSHUXUEBAO XUEBAO

第17卷 第10期 (总第103期) 2007年10月

 [PDF全文下载]

文章编号: 1004-0609(2007)10-1609-07

### 等离子喷涂热障涂层的隔热性分析

周洪, 李飞, 何博, 陆燕玲, 王俊, 孙宝德

(上海交通大学 金属基复合材料国家重点实验室, 上海 200030)

**摘要:**采用大气等离子喷涂方法制备不同类型的氧化钇部分稳定氧化锆热障涂层: 传统涂层、纳米团聚粉末制备的纳米涂层和空心球粉末制备的空心球涂层。通过扫描电镜、透射电镜、压汞仪和激光脉冲法观察和测试各种涂层的组织形貌、空隙分布和导热系数, 并在相同条件下测试各种涂层的隔热性能。结果表明: 纳米涂层空隙率最低, 内部孔洞细小。空心球涂层组织相对疏松, 内部层片更薄, 有最高的空隙率和最大的平均空隙大小。传统涂层介于二者之间。纳米涂层和传统涂层均表现出双态空隙大小分布。涂层的导热系数均随着温度的上升而升高。传统涂层的热导率最高, 纳米涂层与空心球涂层的热导率相接近。纳米涂层具有最好的隔热性能, 空心球涂层接近纳米涂层的隔热效果。隔热效果与涂层厚度呈线性关系。随着厚度增加, 导热系数低的纳米涂层和空心球涂层的隔热效果增长幅度高于传统涂层。

**关键字:** 热障涂层; 大气等离子喷涂; 纳米; 空心球粉末; 隔热性能

### Analyses on thermal barrier effects of zirconia based thermal barrier coatings

ZHOU Hong, LI Fei, HE Bo, LU Yan-ling, WANG Jun, SUN Bao-de

(State Key Laboratory of Metal Matrix Composites, Shanghai Jiao Tong University, Shanghai 200030, China)

**Abstract:** Different zirconia based thermal barrier coatings (TBCs) were fabricated by air plasma spraying including the conventional TBCs, the nanostructured TBCs from the reconstituted nanoparticles (the nano-coatings) and the special TBCs from the hollow spherical powder (the HSP coatings). The microstructures and properties of the different coatings were studied by transmission electron microscopy (TEM), scanning electron microscopy (SEM) and mercury intrusion porosimetry (MIP). Laser flash technique was used to examine the thermophysical properties of the different coatings. Thermal barrier effects for all the specimens were tested by a self-made device under the same conditions. The results reveal that the nanostructured TBC with the smallest micropores has the lowest porosity, whereas the HSP coatings show a relatively looser microstructure with the largest porosity and thinnest splats. Both the conventional coatings and the nano-coatings present a typical bimodal pore size distribution. In general, the thermal conductivities of all the coatings increase slightly with increasing temperatures. The conventional coating has the highest thermal conductivity among all the coatings. The thermal conductivity of the HSP coatings is similar to that of the nano-coatings. The nano-coatings show the best thermal barrier effect and the

HSP coatings also present a good thermal barrier effect. The thermal barrier effect is proportional to the TBC's thickness. With the increasing thickness of coatings, the thermal barrier effect increases more for the coatings with low thermal conductivity than that with high thermal conductivity.

**Key words:** thermal barrier coatings; air plasma spraying; nanostructure; hollow spherical powder; thermal barrier effect

版权所有：《中国有色金属学报》编辑部

地 址：湖南省长沙市岳麓山中南大学内 邮编： 410083

电 话： 0731-8876765, 8877197, 8830410 传真： 0731-8877197

电子邮箱： [f-ysxb@mail.csu.edu.cn](mailto:f-ysxb@mail.csu.edu.cn)