

论文

激光原位制备颗粒增强铁基复合涂层中碳化物相的形貌分析

吴朝锋, 马明星, 吴爱平, 刘文今, 钟敏霖, 张伟明, 张红军

1) 清华大学机械工程系先进成形制造教育部重点实验室, 北京 100084 2) 北京光电技术研究所, 北京 100010

摘要:

通过Zr+Ti, Ti+WC以及Zr+Ti+WC的复合添加, 运用激光熔覆技术在中碳钢表面原位合成了颗粒增强铁基复合材料涂层, 研究了复合碳化物颗粒相的形貌特征. 结果表明, 当Zr+Ti复合添加时, 颗粒相具有包覆结构; 当Ti+WC复合添加时, 颗粒相易长大成花瓣状, 具有层状结构; 当Zr+Ti+WC复合添加时, 若WC含量较低, 颗粒相具有不规则多边形特征, 随着WC含量的增加, 颗粒相逐渐长大成花瓣状甚至粗大的树枝晶状. 通过热力学计算, 对复合碳化物的形成过程进行了讨论.

关键词: 激光熔覆 颗粒增强 复合碳化物 铁基复合涂层 热力学

MORPHOLOGIC CHARACTERISTICS OF IN SITU SYNTHESIZED CARBIDE PARTICLES IN LASER CLADDED Fe-BASED COMPOSITE COATINGS

WU Chaofeng, MA Mingxing, WU Aiping, LIU Wenjin, ZHONG Minlin, ZHANG Weiming, ZHANG Hongjun

1) Key Laboratory for Advanced Materials Processing Technology, Ministry of Education, Department of Mechanical Engineering, Tsinghua University, Beijing 100084

2) Beijing Institute of Opto--Electronic Technology, Beijing 100010

Abstract:

Particle reinforced metal matrix composite (PR-MMC) has attracted extensive investigation in material science and engineering. Laser depositing of MMC coatings containing in situ carbide particles is a research focus in laser surface processing field. Recent literatures have indicated that the particle size and distribution play an important role on the wear resistance of laser clad coatings. It is necessary to analyze the morphologic characteristics of the particles. In this paper, particle reinforced Fe-based composite coatings were produced by laser cladding Fe-based alloy powders containing Zr+Ti, Ti+WC and Zr+Ti+WC, respectively, on the surface of a medium carbon steel. The carbide particles were analyzed by XRD, SEM and TEM. The results show that during the growth of composited carbide particles, a type of surrounding structure, the inside part of the particle is (Zr, Ti)C while the peripheral part is (Ti, Zr)C, forms when 12%Zr and 3%Ti (mass fraction) are added. When 1%-5% Ti and 10%WC are added, the particles present petal-like shape with layered structure. When Zr, Ti and WC (7%-10% of Zr and Ti) are added, the particles present irregular polygon shape as low content of WC (5%) added, but become petal-like or even dendrite shape when the content of WC is high (10%-15%). Although the particles have high content of W (30%-50%), they still have TiC structure. The formation mechanism is discussed based on thermodynamic calculations. It is indicated that different strong carbide-forming elements (SCFE) play different roles in the nucleation and growth of particles. Zr and Ti are important elements for particle nucleation. The concentration of W into the particle has a great influence on the growth of the particles. Therefore, the addition of WC can enlarge the particle size and decrease the amount of particles meanwhile. The above results are helpful to select the suitable proportion of SCFEs on laser cladding PR-MMC coatings.

Keywords: laser cladding particle reinforcement composited carbide Fe-based composite coating thermodynamics

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通讯作者: 吴朝锋

作者简介: 吴朝锋, 男, 1982年生, 博士生

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