Phase and structure formation mechanisms of SHS synthesized composite coatings

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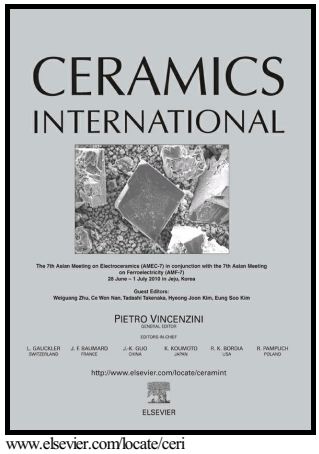

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Phase and structure formation mechanisms of SHS synthesized composite coatings

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Abstract

High performance composite coatings were synthesized by self-propagation high-temperature synthesis followed by gravitational-separation process based on thermite reaction. The phase, structure and composition of generated composite coatings were investigated, and formation mechanism was studied by thermodynamic analysis. Results showed that phase composition of Al-Fe_2O_3 reaction system consisted of Al_2O_3, Fe and $FeAl_2O_4$. In Al-Fe_2O_3/Al-Cr_2O_3 composite reaction system, Fe-Cr alloy was formed and $FeAl_2O_4$ phase disappeared, which could improve the corrosion resistance of composite coatings. Furthermore, the addition of SiO_2 in SHS reaction favored the formation of low-melting point phase $Al_2O_3{\cdot}SiO_2$, which filled into voids of Al_2O_3 dendrites and reduced the porosity of composite coatings, thus improving their strength and densification level. Moreover, the generated transition structure in different reaction systems could buffer the residual stress to promote the binding between the composite coating and steel pipe.

Keywords: composite coating; SHS-GS method; corrosion resistance; low-melting point phase; densification

1. Introduction

Self-propagation high-temperature synthesis (SHS) is a recent and attractive material synthesis technique that has been widely used in the preparation of ceramic materials, compound materials, functionally gradient materials, surface modification of materials and other fields, and many achievements have been reported [1, 2]. In comparison with the traditional material synthesis techniques, combustion synthesis