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In situ composite coatings prepared by complex reactive plasma spraying of**Fe₂O₃-Al-Cr₂O₃ composite powders**

Dian-ran Yan ^{1,2}, Yong Yang ^{1,2,*}, Zhen-hua Chu ^{1,2}, Xue-guang Chen ¹, Xue-rui Dai ¹, Yan-hui Wang ¹, Yan-chun Dong ^{1,2}

1. Key Lab. for New Type of Functional Materials in Hebei Province, School of Materials Science and Engineering, Hebei University of Technology 300132, Tianjin, China

2. Tianjin Key Laboratory of Materials Laminating Fabrication and Interface Control Technology, Hebei University of Technology 300130, Tianjin, China

*Corresponding author: Yong Yang; Tel: +86-22-60204810; Fax: +86-22-26564810; E-mail: yangyonghebut@163.com, yangyong@hebut.edu.cn.

Postal address: No. 29 Guangrong Road, Hongqiao District, Tianjin 300132, P.R. China

Abstract:

Complex reactive plasma spraying (CRPS) was carried out by plasma spraying Fe₂O₃-Al-Cr₂O₃ composite powders. Two aluminothermic reactions, Al-Fe₂O₃ reaction and Al-Cr₂O₃ reaction, occurred at the same time in the plasma jet, and CRPS coatings were prepared. The effects of the complex reactions on the microstructure of the coatings were investigated by XRD, SEM and TEM. Hardness and toughness of the coatings were also evaluated. It was found that, compared to a single aluminothermic reaction (Al-Fe₂O₃ reaction), the phase composition of the CRPS coatings changed as follows: FeAl₂O₄ → Fe(Cr,Al)₂O₄ → FeCr₂O₄, α-Fe → α-(Fe,Cr), and Al₂O₃ → (Al_{0.9}Cr_{0.1})₂O₃. The amount of metal phases increased, and large-sized metal particles were replaced by nano-sized metal particles uniformly dispersed in a ceramic matrix. Hardness and toughness of the coatings increased with increasing Al-Cr₂O₃ ratio in the composite powders. Nano-sized metal particles replaced large-sized metal particles and were uniformly distributed in the ceramic matrix resulting in the increase of hardness and toughness of the complex reactive plasma sprayed coatings.

Key words: Coating materials; Metals/ceramics coating; Complex reactive plasma spraying; Aluminothermic reaction; Microstructure

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