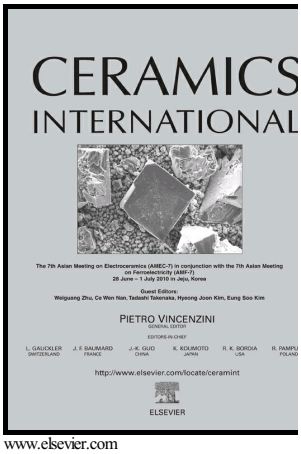

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Impact-induced bonding and boundary amorphization of TiN ceramic particles during room temperature vacuum cold spray deposition

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Abstract

Vacuum cold spray (VCS) has been developed as a competent technique for room temperature bulk coating fabrication of solid ceramic particles. Here we report formation and densification mechanisms of VCS TiN ceramic coatings as elucidated by characterizing their microstructures at particle/substrate and particle/particle interfaces. TEM observation reveals apparent fracturing and plastic deformation of TiN particles during impact deposition. The deformation located at the interfacial areas exhibits a dislocation density of ~$5\times10^{17}/m^2$. Formation of an amorphous layer with the width of 3-4 nm at the fringes of the ceramic particles is revealed. Impact velocity and high strain rate of TiN particles as determined by numerical computation further indicates the substantial role of the impact-induced plastic deformation in regulating the fabrication of the coatings. The results shed light on efficient room temperature bulk fabrication of ceramic materials with tunable structures.

Key words: grain boundaries; interfaces; electron microscopy; nitrides.

1. Introduction

As one of the most recently developed coating techniques, cold spray offers competitive advantages and exciting opportunities for heat-sensitive materials for bulk coating fabrication