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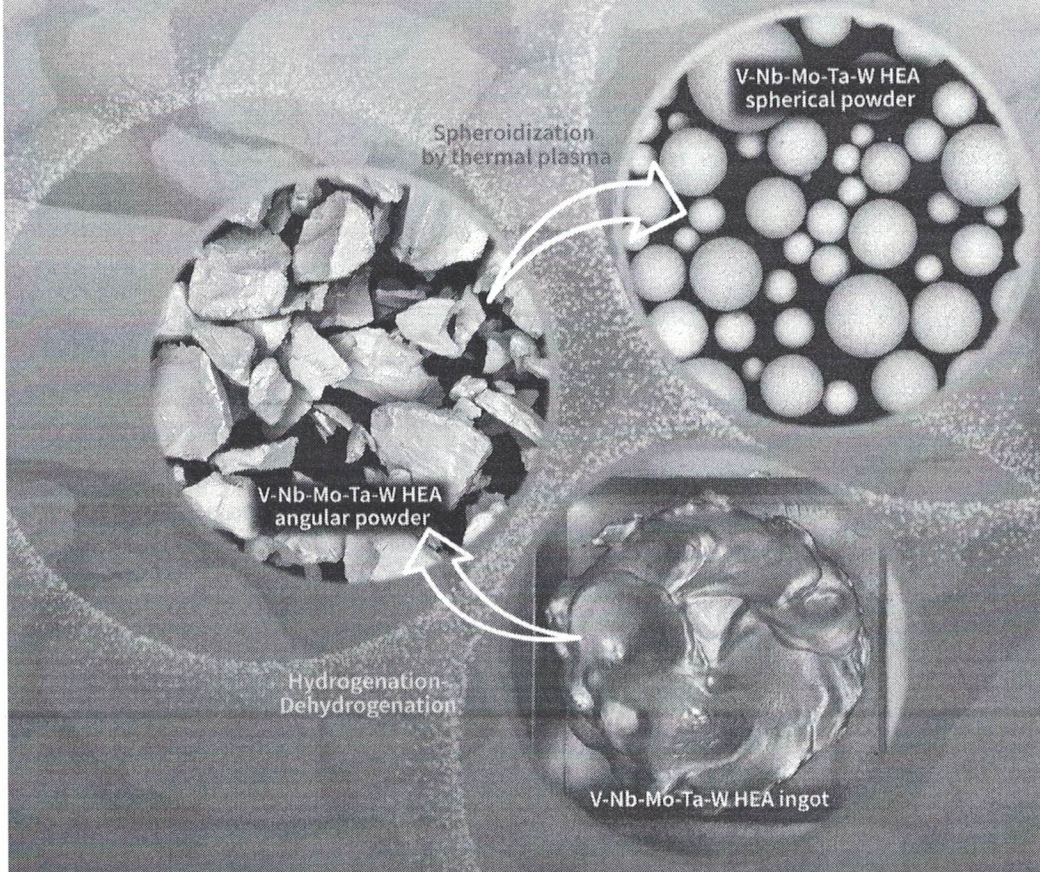

Synthesis of Spherical V-Nb-Mo-Ta-W High Entropy Alloy Powder

Volume 9 · Issue 12 | December 2019

MDPI

mdpi.com/journal/metals
ISSN 2075-4701

Imprint

Full Journal Title	Metals
ISO4 Abbreviated Title	Metals
ISSN (electronic)	2075-4701
CODEN	MBSEC7
Publisher	MDPI AG
Publisher Location	Basel, Switzerland
Postal Address	MDPI, St. Alban-Anlage 66, 4052 Basel, Switzerland
Editors	see: **Editorial Board (/journal/metals/editors)**
Publication Frequency	monthly
Publication Medium	electronic only
Publication Website	**https://www.mdpi.com/journal/metals (https://www.mdpi.com/journal/metals)**
First Year Published	2011
Indexing Databases	see: **Indexing & Abstracting (/journal/metals/indexing)** Covered by the Science Citation Index Expanded (SCIE, Web of Science).
Impact Factor	2.259 (2018)
5-Year Impact Factor	2.371 (2018)

Metals (/journal/metals), EISSN 2075-4701, Published by MDPI AG

RSS (/rss/journal/metals) **Content Alert (/journal/metals/toc-alert)**

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Article

Effect of the Average Energy on WC Grain Growth of WC-10Co-4Cr Composite by Laser Cladding

Enrique A. López-Baltazar [1,2,*], Haideé Ruiz-Luna [3], Víctor H. Baltazar-Hernández [2], José Jorge Ruiz-Mondragón [4], Juansethi Ibarra-Medina [5,6] and Juan Manuel Alvarado-Orozco [5]

1 CIATEQ, Manufactura Avanzada Sede Aguascalientes, Aguascalientes 20358, Mexico
2 Materials Science and Engineering Program, Universidad Autónoma de Zacatecas, Zacatecas 98000, Mexico; victor.baltazar@uaz.edu.mx
3 CONACYT-Universidad Autónoma de Zacatecas, Zacatecas 98000, Mexico; hruizlu@conacyt.mx
4 Corporación Mexicana de Investigación en Materiales SA de CV, Coahuila 25290, Mexico; jjorge.ruiz@comimsa.com
5 Centro de Ingeniería y Desarrollo Industrial, Queretaro 76125, Mexico; juansethi.ibarra@cidesi.edu.mx (J.I.-M.); juan.alvarado@cidesi.edu.mx (J.M.A.-O.)
6 Dirección de Cátedras-CONACYT, Consejo Nacional de Ciencia y Tecnología (CONACYT), Ciudad de Mexico 03940, Mexico
* Correspondence: ealopezb@gmail.com

Received: 25 October 2019; Accepted: 19 November 2019; Published: 21 November 2019

Abstract: In the present study, the microstructure evolution of WC-10Co-4Cr powder deposited on AISI-SAE 1020 steel substrate by laser cladding was evaluated, considering the effect of average energy per unit area. Single tracks were obtained by employing a Yb: YAG laser system with selected processing parameters. All samples were sectioned in the transverse direction for further characterization of the cladding. Results showed that dilution lay within 15% and 25%, whereas porosity was measured below 12%. According to microstructural analyses, considerable grain growth is developed within the central area of the cladding (namely, the inner region); additionally, the development of a triangular and/or polygonal morphology for WC particles along with a clear reduction in hardness was observed when employing a high average energy. It is worth noting that, in spite of the rapid thermal cycles developed during laser cladding of WC-10Co-4Cr, grain growth is attributed to a coalescence mechanism due to complete merging of WC into larger particles. Finally, the presence of small round or ellipsoidal particles within the inner region of the cladding suggested that non-merged particles occurred due to both an inhomogeneous dispersion and the lack of faced-shaped WC particles.

Keywords: WC-10Co-4Cr; laser cladding; average energy per unit area; grain growth

1. Introduction

WC-10Co-4Cr composite or alloy is widely used for coating applications in aeronautics, mining, construction, and heavy machinery industries [1,2]. In general, WC-Co-Cr based coatings are characterized by having high hardness and high wear, erosion, and corrosion resistance [3,4].

Laser cladding (LC) is an industrial manufacturing process that produces dense, crack-free, and low-porosity coatings with excellent bonding properties [5,6]. It has been established that the key processing parameters in LC are the laser power, the scanning speed, and the powder feeding rate, which strongly influence the geometrical characteristics of LC tracks, including aspects such as dilution, width, and wetting angle [7–9]. With the purpose of establishing a relationship among three different processing parameters, that is, laser power, scanning speed and laser spot diameter, the concept of