A P/M SINTERING APPROACH FOR COATING 15-5PH STAINLESS STEEL

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ABSTRACT

Cylinders for a given application need to achieve significant wear resistance and dimensionally fit within tight tolerance specifications. These requirements have been met by electrolytically depositing chrome and performing finishing operations. Because of the recurrent cost associated with the electroplating process, the price of chrome and EPA regulations on the use and disposal of chemicals, it is imperative to find a process and material alternative. Several carbide candidates were chosen, mixed with a nickel-based matrix and liquid phase coated onto a substrate. The matrix was designed to achieve appropriate solubility, wetting and solid phase diffusion during the sintering phase. It was also chosen to be compatible with the substrate and thus withstand any heat treatment necessary to achieve the properties of a 15-5PH stainless steel. We studied the statistical significance of solids loading, sintering hold time and grain size variations onto the coating hardness and other microstructural properties.

INTRODUCTION

Coating technology for wear resistance application include a wide variety of processes such as electroplating, thermal spraying, chemical vapor deposition and physical vapor deposition to name a few. To date, electroplating is one of the most economical processes for coating complex geometries. There are however several serious disadvantages to this process. They include: the environmentally unfriendliness of the chemicals in the deposition bath, the brittle nature of chrome plating with a ductility far less than 0.1%, the presence of cracks and microcracks in the coating, which increases the risk of catastrophic failures and the risks of failures associated with hydrogen embrittlement. The focus of our study is on finding an alternative to electroplating for non-horizontal surfaces. The line of sight constraint have eliminated the possibility of using many the thermal spraying processes as well as vapor deposition techniques. What is researched is the development of a process based on tungsten carbide with an nickel-iron alloy matrix. This paper is a preliminary study that will serve as a foundation to the evaluation of tungsten carbide –nickel-iron wear resistance performances.

The characteristics of metal matrix composites of type WC-Nickel have been known to be suitable for applications requiring high wear resistance properties. Tungsten carbide cobalt or nickel belong to the category of cemented carbides and are used in areas such as tool cutting as well as rock drilling, mining applications and excavations. All the applications mentioned above require a material with a high resistance to abrasion wear. Nowadays iron-nickel is being used as a replacement of cobalt for several reasons. Provided a close carbon control is achieved, WC-iron-nickel will obtain strength and abrasion resistance properties comparable to those of WC-cobalt (Larsen Basse, 1981). The controlled presence of carbon is of prime importance, as an insufficient amount leads to the creation of an eta phase (e.g. Co_3W_3C for Co binders and Ni_3W_3C for iron based binders). Mainly caused by its brittle nature, this eta phase is detrimental to the material' s mechanical properties probably. (Moskowitz et. al., 1970)