Chapter 7
Fabrication of Functionally Graded Metal and Ceramic Powders Synthesized by Electroless Deposition

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ABSTRACT

One of the most important factors in powder metallurgy is the powder properties that directly affect the final product properties. By using the functionally graded materials (FGMs) in powder metallurgy, the desired properties can be obtained by means of layers having microstructure having more than one feature in a single material structure. Similarly, by the production of functionally graded powders (FGPs), different properties can be obtained in a single powder structure and the materials that have different properties in the same structure are developed by integrating these powders with powder metallurgy. In this context, the FGMs synthesized from the FGPs produced by electroless deposition (ED) of metal or ceramic-based powder materials facilitates the production of advanced material. Therefore, the purpose of this chapter is on the fabrication of metal and ceramic-based FGPs by ED and to discuss of their advantages on the powder metallurgy parts.

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INTRODUCTION

The emergence of delamination problems in the matrix and reinforcement material of composite materials developed as a solution to the problems such as corrosion and wear of conventional mono-component or alloy materials has encouraged researchers to produce a new type of material. These novel materials were called as functional graded materials (FGMs) whose features change gradually corresponding with the dimensions in the structure (Ning Zhang et al., 2019). These materials are widely used in electrical, aerospace, energy, automotive, bioengineering and many other applications. Since conventional engineering materials do not provide the desired properties, they are highly advantageous in terms of obtaining different material properties in a single structure. The application areas of FGMs are shown schematically in Figure 1.

Figure 1. Application areas of FGMs

Depending on these applications, considering the characteristics such as abrasion, corrosion, chemical stability, electrical and thermal conductivity, providing different properties in different layers of a single material structure makes FGMs indispensable (Edwin, Anand, & Prasanna, 2017; El-Galy, Saleh, & Ahmed, 2019; A. Gupta & Talha, 2015) . FGMs are often structurally divided into two types. In the first kind FGMs, the composition in the material structure changes step by step, while the composition in the second variant shows a continuous change. In this context, FGMs can be produced from different layers and using different materials in each layer. On the other hand, FGMs with different grain sizes can be produced in the same structure by obtaining materials with different grain sizes in each region (lower-middle-upper) (Chi Zhang et al., 2019). This type of FGMs is shown schematically in Figure 2.