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Changes of Fe matrix's lattice constant during liquid phase sintering of Fe-Cu-C compacts by x-ray diffraction techniques

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ABSTRACT The dissolution of graphite and copper during sintering of PM steels prepared from iron, copper and graphite powder mixes were studied using X-Ray Diffraction method. This paper present the investigation carried out to study the changes of iron's lattice constant during liquid phase sintering of the compacts. The electrical conductivity measurement method was also used for determining the extent of carbon and copper dissolution and its influence on the formation of sintered compacts. In the experiment, the Fe-Cu-C powders were compacted into a pellets using hand press machine and were then sintered in a 5% H_2 + 95% N_2 gas atmosphere at different sintering temperature in the range of 400 °C and 1200 °C. The effect of sintering parameters on the mechanical properties of the sintered compacts was studied to find a correlation between mechanical behaviour, microstructure, and the resistivity in order to develop non-destructive testing method. It was observed that measurement of Fe matrix's lattice constant and electrical conductivity of sintered compacts could be a viable method in studying all stages of sintering process.

(Lattice constant, Electrical conductivity, Liquid phase sintering, Microstructure)

INTRODUCTION

In the manufacturing of sintered steels parts, carbon is the most effective alloying elements additive because of its manifold reciprocal effects on iron and other alloying element. For technological and economical reasons this inexpensive material is introduced in the form of graphite powder. Therefore, knowledge of the dissolution behaviour of carbon in the iron matrix during sintering is importance for quality assurance [1-2].

Surprisingly, the mechanism, despite its technical importance, is not well understood. Another approach for studying the carbon dissolution mechanism and the influence of manufacturing condition was regarded necessary [3]. Electrical conductivity measurement could be an interesting method for evaluating possible variation in material structure occurring during processing of sintered parts [4].

The use of X-Ray Diffraction method in the study of the dissolution of graphite and copper in iron matrix during sintering of PM steels prepared from iron, copper and graphite mix has not yet been reported by other investigators. The purpose of this work is therefore to discuss the applicability of this technique for determining the dissolution of copper and graphite in iron matrix and the electrical for conductivity measurement as a reliable method for determining the changes in material structure occurring during sintering of the compacts.

MATERIALS AND METHOD

Raw Material

A commercial grade powders used for this study were iron, copper and carbon. Zinc Stearate was used as lubricant to provide effective lubrication between powder particles, uniform pressure distribution during compaction and to facilitate ejection part from the die after pressing. The powders were characterised for pycnometric density measurement and particle size as tabulated in Table 1. Pycnometry density was