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Study on Machinability of Laser Sintered Materials Fabricated By Layered Manufacturing System: Influence of Different Hardness of Sintered Materials

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Abstract

This paper investigates machinability of laser sintered materials fabricated by layered manufacturing system. Different types of sintered materials; chromium molybdenum (SCM) sintered material and maraging steel (MAS) sintered material were fabricated by using selective laser melting (SLM) method. Measurement of cutting force and cutting temperature were carried out by using ball end mill in order to understand the influence of different hardness of sintered materials on machinability. Bulk carbon steel (JIS S55C) was selected as reference steel. Experimental results show that MAS sintered material is difficult to machine material where cutting force of MAS sintered material was higher than SCM sintered material. However, even though MAS sintered material has higher hardness than SCM sintered material, cutting temperature was low due to high thermal conductivity. From these results, MAS sintered material can be considered as good material to produce mold due to its high hardness and good machinability.

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1. Introduction

Recently, layered manufacturing has become a popular topic among researchers and manufacturers, and one of the examples is milling-combined laser sintering system. Milling-combined laser sintering system is a rapid tooling machine that combines laser sintering of fine metallic powder and high speed milling processes. This system is developed to manufacture molds, prototypes and tools with high dimensional accuracy and good surface roughness in just one process. By employing this technique, even a complicated mold can be manufactured in shorter time and also requires less production cost[1]. However, due to the rapid heating

and cooling during the laser sintering process, the repetition of thermal expansion and shrinkage generate residual stress within the sintered structure which causes deformation and micro crack problems[2]. In addition, laser-sintered material can be considered as difficult to machine material due to its porosity and inhomogeneous in terms of its mechanical and thermal property. Therefore, production of mold with superior strength, toughness and also good machinability are very important.

In this research, two types of metal powder were used to produce laser sintered materials by using selective laser melting (SLM) method. Fabricated sintered materials were totally different in hardness and in order to understand the characteristic of the sintered materials,