Study on Vibration-suspense-type Metal Powder-coating Process for Selective Laser Sintering

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Abstract

In this paper, Vibration-suspense-type process is used to develop a new material, metal or porcelain powder coated with resin or ceramic powder, then it can be sintered and formed without large-power laser. One set of vibration-suspense-type powder-coating equipment is developed and powder material suitable for SLS can be prepared with the equipment. The moving status and the moving process of powder granule in the vibration-suspense-type process are also analyzed. Based on the equipment, Polystyrene- Al powder material, which is suitable for SLS, is successfully prepared. And the optimum process is discussed.

Introduction

Totally different from the traditional method which forms roughcast in mould cavity and then cuts it to get components, Selective Laser Sintering (SLS) is a new-developed material forming method which deals with freely-piling material and getting components in the volume-integral way controlled by a computer. It owns special attributes such as rapid speed, forming components without die, and sintering any complex 3-dimension object etc and thereby it can greatly decrease the time of product development, reduce the development expense and enhance the chance to develop products successfully. Therefore, SLS has a great application in many fields, especially in the industrial one. The super target of the rapid fabrication accomplished by rapid prototyping (RP) is that a metal part with the high function and complex shape is quickly fabricated using rapid prototyping, and this process has a very wide application in future. Making metal parts using selective laser sintering (SLS) system is bright in future among the commercial RP systems. There are two kinds of processes. Direct process, metal powders are directly sintered to fabricate a metal part, is a hot and difficult problem in the world. Another one is that a coated metal powder is sintered to fabricate indirectly a metal part. To develop a new material, metal or porcelain powder coated with resin or ceramic powder, and then it can be sintered and formed without large-power laser part.

1. Design of the powder-coated equipment

The powder-coated process is: preheating metal powder fall from the upper cylinder, resin powder blown from the down cylinder, and gas make it as suspended state. Resin powder melt by the heat metal powder, and the resin coated on the metal powder surface .and the powder drop into the liquid, the coating process is completed. Fig 1shows the schematic diagram of the powder-coated equipment. And table 1 shows best the experiment parameter.

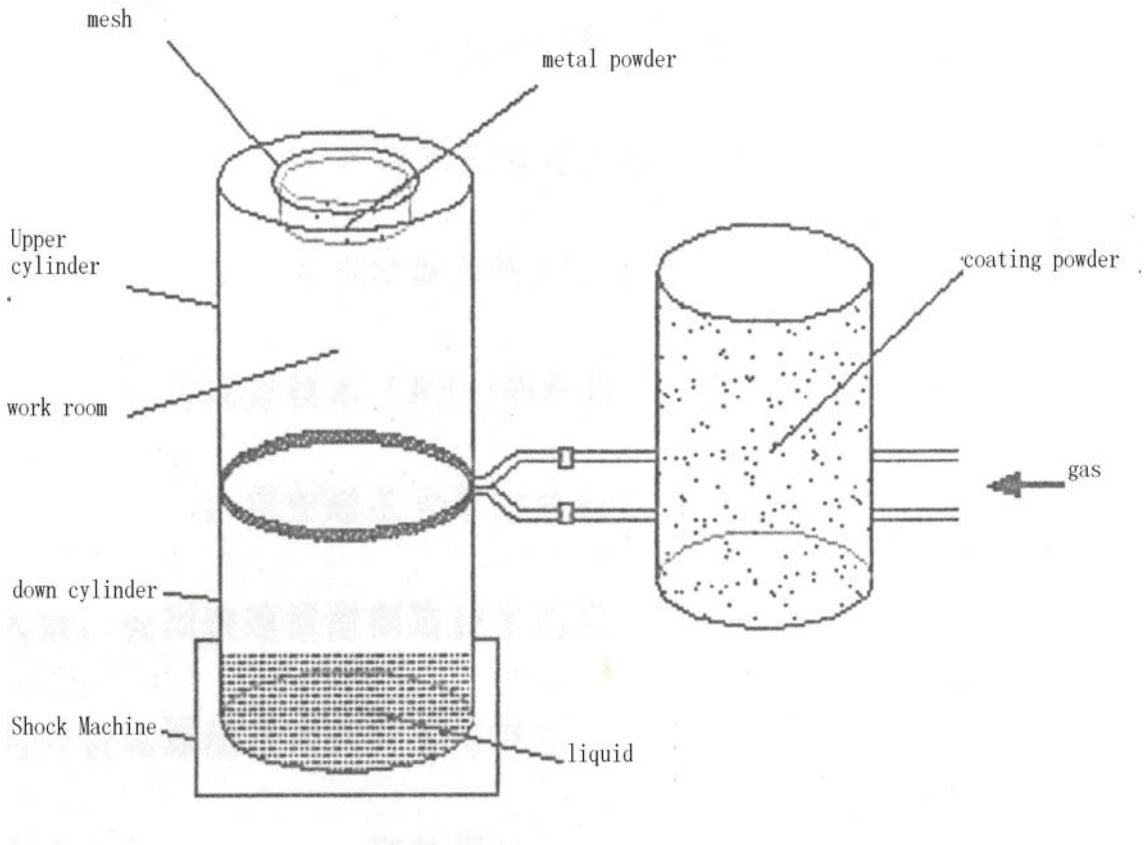


Fig 1 the schematic diagram of the powder-coated equipment

Tab 1 Experiment scheme design & experiment result

	vibration frequency(r/min)	Atmospheric pressure (MPa)	Preheat temperature (℃)	Coating effect
1	1700	0.4	200	Incomplete
2	1700	0.5	220	good
3	1700	0.6	240	Incomplete
4	1800	0.4	220	Incomplete
5	1800	0.5	240	good
6	1800	0.6	200	Incomplete
7	1900	0.4	240	Incomplete
8	1900	0.5	220	Incomplete
9	1900	0.6	200	Incomplete

2. Experimental result

Tab 2 Features of raw metal powders

Metal	Particle dimension(um)	Purity(wt%)	Particle shape
Al	61-105	99.99	Spherical

We choose the most common metal material in industrial, Al as raw material. Use atomization process to get AL powder .The features of AL powder shown in table 2. In SEM, Al powder particles showed a regular sphere, very good roundness.

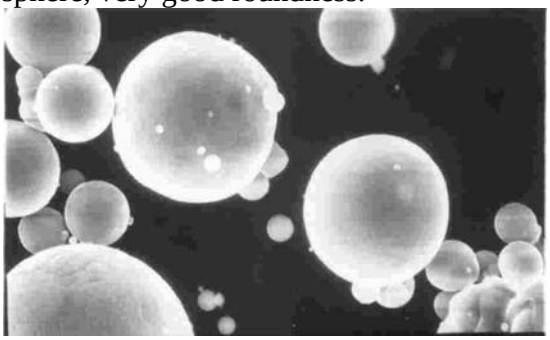


Fig 2 SEM morphology of Al metal powder particle shape

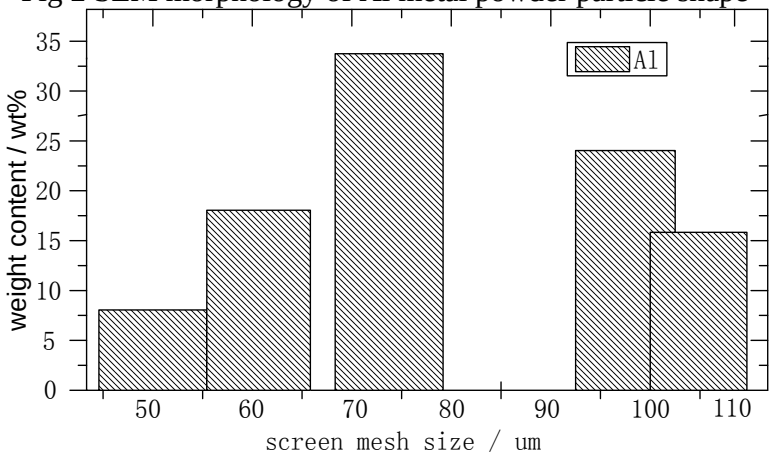
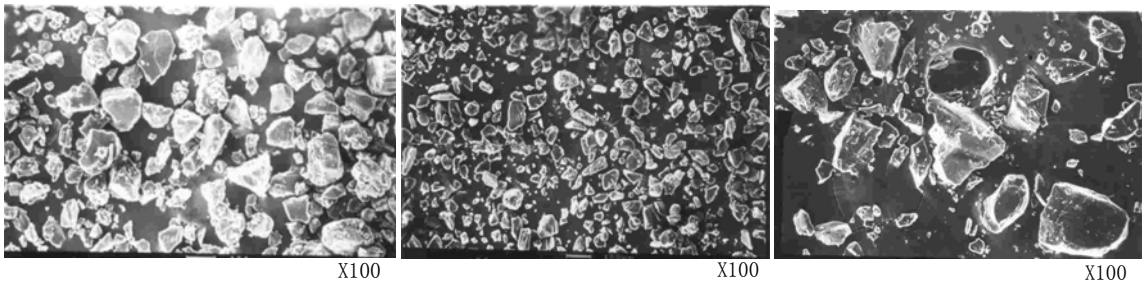


Fig 3 powder screen mesh size distribution

Coating materials choose: POLYSTYRENE 、paraffin、SYF-125. In SEM, Al powder particles showed a regular sphere, very good roundness. The particle shape uniformity of Polystyrene and paraffin wax are better than SYF-125.



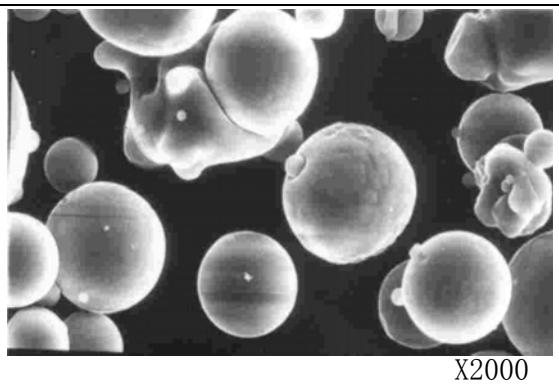
PS Paraffin SYF-125

Fig 4 SEM morphology of powder particle

By selective laser sintering test, tab 3 shows the best coating powder content.

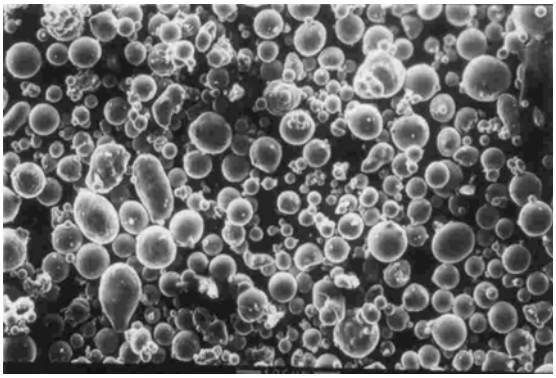
Tab 3 experimental composition of coated Al powder

Al-P	Polystyrene content (wt %)	5.0	AL(wt%)	95.0
Al-W	Wax content (wt %)	8.0	AL(wt%)	92.0
Al-S	SYF-125 content (wt %)	14.0	AL(wt%)	86.0



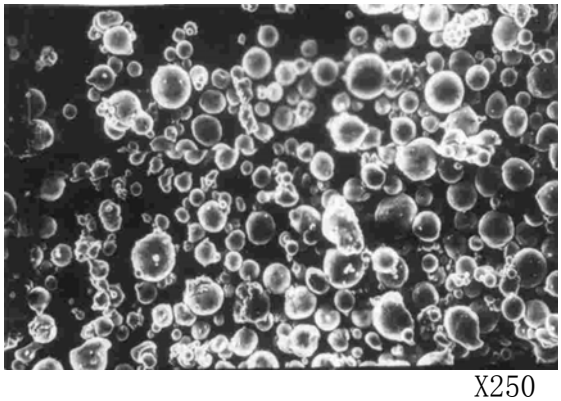
X2000

Fig 5 SEM morphology of Al-P coating powder



X250

Fig 6 SEM morphology of Al-W coating powder



X250

Fig 7 SEM morphology of Al-S coating powder

CONCLUSIONS

One set of vibration-suspense-type powder-coating equipment is developed and powder material suitable for SLS can be prepared with the equipment. A kind of powder material suitable for SLS, polystyrene –Al, is prepared. The circular ratio of powder granule has such a great impact on coating effect that the more circular the powder granule is, the better coating effect is. The amount of resin or plastic material needed to coat metal or ceramic material apparently ranges according to different resin or plastic material: the more circular the powder granule is and the better the uniform degree is, the less the amount needed is.

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