Development Of Fine Powder Deposition Method Applicable To Multi Material Micro Fabrication (MMMF)

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Abstract

Reducing dimension and multiplying functional aspect of engineering product is a mark of a modern technology product. Therefore, research of micro machining and smart material is an important step to develop the future manufacturing process. Layered manufacturing is one of the propective process of it.

Research of powder deposition is a key of developing multi material micro fabrication. This research was implemented in four steps including materials preparation and characterization, design and manufacturing experiment apparatus, wall friction-flow ability test and design-manufacturing MMMF machine including the mechanical, electronics and software system. The research was initiated by study observation to find information about characteristic of fine powder and method of reducing the cohesiveness. By sieving process, powder was separated into 4 particle sizes including -34, 34-60, 60-74, 74-104 micron. Particle shapes were observed using optical microscope. Wall friction test was performed to observe the effect of wall surface roughness, particle size and material powder on mass flow characteristic, by Jenike method. Flow ability test was carried out to yield the powder flow consistency by varying the particle sizes, models of screw feeder geometry, installing blender mechanism, reducing the particle cohesiveness and the wall friction test parameters (powder quantity in hopper and wall surface roughness). For these experiments, rotation of the screw feeder was fixed at 236 rpm. By plotting the experimental data, the optimum parameter of powder mass flow can be determined and it was tested by varying rotation of the screw feeder.

The experimental results show that the mass flow characteristic is affected by wall surface roughness and particle size. Effect of powder quantity in hopper can be eliminated by installing blender mechanism; it can also reduce the compaction of the powder around nozzle orifice so that the mass flow can be increase. Mass flow characteristic is also affected by hopper angle, in which the optimal angle is achieved at 25.67^o (by variation of 20.6^o, 22.62^o and 25.67^o). Powder mass flow was caused dominantly by stimulating rotation of the screw feeder, it is not by helicoidal surface of the screw feeder. Powders trapped in helicoidal slot drive around particle caused by geometric interlocking. However, increasing screw feeder diameter is an effective way to increase the mass flow of smaller particle size (in this chase smaller than 60 micron). Preheating process gives the effective method to increase the mass flow, particularly for small particle (smaller than 60 micron). By considering these parameters, mass flow capacity can be arranged effectively by controlling rotation of the screw feeder.