NANOPOWDERS IN RAPID PROTOTYPING FOR 3D PRINTING OBJECTS THROUGH SELECTIVE LASER SINTERING TECHNOLOGIES

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Abstract: This paper will deal with some aspects regarding integration of various types of nanopowders with computer aided software engineering, design and manufacturing concepts for better new products development. From design to manufacturing, the new trends in mechatronics focus on faster obtained, better and cheaper new products, aiming to bring the rapid prototyping technologies as a driving force in the new era of manufacturing.

Keywords: nanopowders, CAD, CAM, rapid prototyping, laser sintering systems.

1. Introduction

Laboratory research in mechatronics will develop as a result of the investment will be made in the version of proposed project, namely, arranging in first phase of the spaces required for new equipment and performing the necessary endowment, followed by the acquisition, commissioning and their use application development in the next stages.

For research, after providing skilled human resource in biomechatronics field, is important equipping with specialized high technical level, to match the expected activities of the laboratory. In the biomechatronics field, methods of rehabilitation biomechanical functions had an evolution in time starting with exercise performed by patients under the guidance of a physiotherapist until the development of mechatronic systems complexes such as actuators (micro electrical hydraulic and pneumatic systems), sensors (drivers and biological), rehabilitation robots (assist handling, movement, exoskeleton, social assistance), prostheses, robots therapeutic exercises, cognitive robots etc.

Endowment with research equipment requested are strictly necessary for a research laboratory specialist in order to collaborate in consortia projects with other European laboratories and they can be grouped into the following categories:

- Software and hardware for acquisition, processing measured values, reverse engineering to reconstruct the geometry of anatomical segments, and results dissemination of new aided design technologies and rehabilitation equipment.

- Devices needed to perform the test and biomechanical testing systems in similar conditions to those in vivo since the conception phase

As part of manufacturing equipment, the Formiga P110 is shown below.

![Figure 1: Formiga P110 in position](image1)

Figure 2. With the front door open, the process chamber is shown

![Figure 2: With the front door open, the process chamber is shown](image2)
During the laser sintering process, the plastic powder is briefly heated to a temperature above the melting point by exposure with the laser beam. A solid body is produced by this heating and the subsequent cooling.

In each layer the cross-section of the parts is exposed using the laser beam such that the exposed areas are joined to the layer underneath that has already been solidified.

Figure 3. Example of typical parts and miniaturization capabilities

2. Plastic Materials for Additive Manufacturing

Product information for plastic that was used PA 2200 - Polyamide white
The white powder PA 2200 on the basis of polyamide 12 serves a wide variety of applications with its very well-balanced property profile.

PA 2201 - Polyamide natural
PA 2201 is a white polyamide 12 powder for slightly more translucent parts. It is in compliance with FDA, 21 CFR, §177.1500 9(b) except for alcoholic foodstuff. Apart from that PA 2201 and PA 2200 have similar material properties.

3. Properties

- multipurpose material
- balanced property profile
- high strength and stiffness
- good chemical resistance
- excellent long-term constant behaviour
- high selectivity and detail resolution
- various finishing possibilities (e.g. metallisation, stov enamelling, vibratory grinding, tub colouring, bonding, powder coating, flocking)
  - bio compatible according to EN ISO 10993-1 and USP/level VI/121 °C
  - approved for food contact in compliance with the EU Plastics Directive 2002/72/EC (exception: high alcoholic foodstuff)

4. Applications

- functional parts
- medical applications, e.g. prostheses
- fully functional plastic parts of highest quality
- substitute typical injection moulding plastics
- realisation of movable part connections

Figure 4. EOS PA2200, 80 micrometers magnification

5. PPP parameter sets

For the production of parts with different requirement profiles, special parameter sets with qualified material and process properties are available; these sets are termed PPP parameter sets. Independent of which PPP parameter set was used and on which machine a part was manufactured, the same part properties are ensured.

6. Balance

The PPP parameter set Balance is built with a layer thickness of 0.12 mm. With its balanced relationship between manufacturing costs, mechanical properties, surface quality and accuracy it is suitable for the widest range of geometries, part sizes and requirements.

7. Performance

The PPP parameter set Performance is built with a layer thickness of 0.10 mm. Its outstanding feature is its isotropic strength and stiffness in all three spatial directions. The fine resolution in this layer thickness ensures very high detail resolution and surface quality at the same time. It is suitable for medium to small parts with high quality requirements. This parameter set is the standard parameter set for the FORMIGA P 110.

8. TopQuality

The PPP parameter set TopQuality is built with a layer thickness of 0.06 mm. With this layer thickness it is possible to build small to medium-sized parts with extremely fine and fragile geometries and the highest surface quality. The building height with this parameter set is limited to 300 mm.
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Figure 5. EOS PA2200, 4 micrometers magnification

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Priority Axis

AP2: COMPETITIVENESS THROUGH RESEARCH - DEVELOPMENT AND INNOVATION.

Area of Intervention

D2.2: Investments in RDI infrastructure and administrative capacity.

Operation

O2.2.1: Development of existing CD and creation of new infrastructure (laboratories, research centers)

9. References

Journals:


WWW resources:

[10] www.eos.info