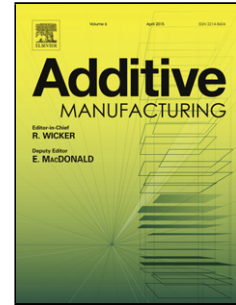


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# Laser Sintering of nano-Hydroxyapatite coated Polyamide 12 powders

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## Abstract

As part of a larger study on the Laser Sintering (LS) of nano-composite structures for biomedical applications, a wet mixing method was used to coat Polyamide 12 (PA12) particles with nano-hydroxyapatite (nHA). The addition of nHA significantly affected powder processability due to laser absorption and heat transfer effects which led to part warping. This phenomenon has not been reported in other studies investigating LS of polymer/HA and nHA powders. Nano-composites containing 0.5 - 1.5 wt% nHA were successfully produced and tensile testing showed that 0.5 wt% nHA provided the greatest reinforcement with a 20% and 15% increase in modulus and strength respectively. However, the elongation at break had significantly declined which was likely due to the formation of nHA aggregates at the sintering borders following the processing of the coated powders despite being initially well dispersed on the particle surface.

### Keywords:

Laser sintering, polyamide, hydroxyapatite, nanocomposite

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## 1. Introduction

The ability to construct highly complex, three dimensional (3D) structures from a variety of degradable and non-degradable polymers makes powder based additive manufacturing processes, such as Laser Sintering (LS), very promising in the field of bone tissue engineering. A laser (typically CO<sub>2</sub>) acts on a preheated powder bed to selectively melt the surface of the polymer particles which fuses them together. Each consolidated layer corresponds to a sliced image of a CAD model to be built [1]. When a layer is complete the build platform lowers and a new layer of polymer powder is spread over the previous layer and the process is repeated until the build is complete. LS has several key advantages over traditional methods for producing bone regenerative devices, such as sol-gel, gas foaming and particulate leaching. These include: control over internal and external geometries, part to part reproducibility, and no requirement for expensive moulds or potentially toxic binders associated with conventional methods [2] [3] [4] [5].

Implants and devices that support migration, proliferation and differentiation of bone cells require a well interconnected, porous, 3D structure with modest mechanical strength, typically less than 2 MPa, in order to support the surrounding tissue whilst bone mineralisation occurs. Eventually the load will be transferred from the structure to the newly mineralised bone [6] [7] [8] [9] [10] [11] [12] [13]. Structures made from composite materials such as polymer/inorganic fillers, are being increasingly explored for LS. The overall goal of this approach is to provide a combination of improved mechanical performance along with enhancing the bioactive properties of the fabricated structures. A popular choice of filler is hydroxyapatite (HA: Ca<sub>10</sub>(PO<sub>4</sub>)<sub>6</sub>(OH)<sub>2</sub>) for bone tissue engineering applications due to its similar chemical composition

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