

A  
DISSERTATION REPORT  
ON

# **Design & Development of 3D printing setup and selective laser sintering of bronze powder with varying pulsed frequency**

Submitted in partial fulfillment of the requirements

of the degree of

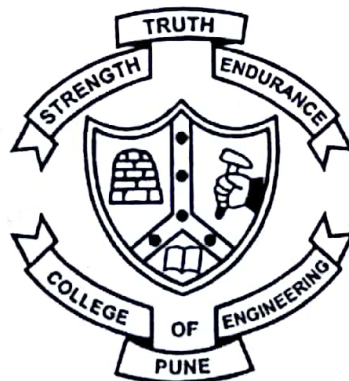
**Master of Technology  
(Materials Engineering)**

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## ABSTRACT

Additive manufacturing process is a technique used to develop prototypes directly from CAD model by joining materials layer by layer. Therefore, complex shapes are possible to produce in short time. Selective laser sintering is one of the additive manufacturing processes. In present work, systems for laser head manipulation and powder bed have been developed to perform operations like, welding, brazing and cladding using a fiber laser. For selective laser sintering, bronze powder with varying particle size distribution was used and laser parameters like power density, pulse frequency, duty cycle were varied. The speed and beam diameter were kept constant. Laser irradiation was made by using continuous mode and pulse mode to understand effect of pulse frequencies with varying duty cycles 5%, 10%, 25%, and 50%. Four powder mixtures without flux and having different particle size distribution were used. Laser sintering of two powder mixtures with flux addition was also conducted. Effects of these variations on sintered density, hardness and microstructure was investigated. The sintered density obtained was between 81 to 93% of bulk density. The specimen with 93% sintered density and average hardness of 66 HR<sub>H</sub> was obtained, when powder mixture of average particle size 49  $\mu\text{m}$  with 1% flux was sintered with power density 176 W/mm<sup>2</sup>, duty cycle of 50% and pulse frequency 500 Hz. The center of specimen showed hardness of 78 HR<sub>H</sub>, while the outside edge hardness was 55 HR<sub>H</sub>. The SDAS values changed as the location on specimen varied. Increase in laser pulse frequency gradually tends to change mode from pulsed to continuous, thereby increases SDAS.