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Authors: R. Rashid, S.H. Masood, D. Ruan, S. Palanisamy, R.A. Rahman Rashid, M. Brandt

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Effect of scan strategy on density and metallurgical properties of 17-4PH parts printed by Selective Laser Melting (SLM)

R. Rashid[a, c], S.H. Masood[a], D. Ruan[a], S. Palanisamy[a, c], R.A. Rahman Rashid[a, c], M. Brandt[b]

[a] *Faculty of Science, Engineering and Technology, Swinburne University of Technology, Victoria 3122, Australia.*

[b] *Advanced Manufacturing Precinct, School of Aerospace, Mechanical and Manufacturing Engineering, RMIT University, Victoria 3001, Australia.*

[c] *Defence Materials Technology Centre, Victoria 3122, Australia.*

Abstract.

Selective Laser Melting (SLM) is a metal additive manufacturing process wherein a laser beam is used to melt and fuse metal powder layer by layer to create a part. This technique involves the interaction of various process parameters such as laser power, scanning speed, powder layer thickness and scan strategy. In this study, the effects of two different scan strategies were investigated and the 17-4PH stainless steel samples fabricated using these strategies, both in as-fabricated and heat-treated conditions, were characterized in terms of relative density, microstructural phase composition and micro-hardness. It was found that the samples printed with double scan strategy showed improvement in the relative density as compared to that printed with single scan strategy. Moreover, it was observed that the samples fabricated using the double scan strategy showed higher hardness than the samples printed using single scan strategy which was attributed to the high phase distribution of martensite than the retained austenite in these samples. In addition, the heat treatment of the as-fabricated samples produced uniform distribution of tempered martensite-dominant phase with negligible retained austenite, resulting in improved hardness as comparable to the heat treated wrought sample.

Keywords. Selective laser melting (SLM), 17-4PH stainless steel, scan strategy, relative density, phase analysis, heat treatment