# Laser based polishing of cobalt chrome and titanium alloy additively manufacture parts

**W.S. Gora[1], Y. Tian[2], M. Mcdonald[1], D. Lunt[2], M. Ardron[3], S. G. Stevenson[3], P. Prangnell[2], N.J. Weston[3], D.P. Hand[1]**

*1- Institute of Photonics and Quantum Sciences, School of Engineering and Physical Sciences, Heriot-Watt University, Edinburgh EH14 4AS, UK*
*2- School of Materials, The University of Manchester, Manchester M13 9PL, UK*
*3- Renishaw plc, Research Park North, Riccarton, Edinburgh EH14 4AP, UK*

The growing popularity of additive manufacturing (AM) has led to extensive research, not only of AM itself, but also regarding techniques to speed up and reduce the cost of the essential post-processing steps. Although great improvements have been made in recent years, the surfaces of as-built AM parts do not have sufficient surface quality for the vast majority of applications. The currently used post-processing techniques for surface improvement are electrochemical or mechanical polishing, but both of these methods have their limitations, particularly in terms of lack of selectivity, chemical waste (electrochemical) or speed, lack of automation (mechanical). Laser polishing has the potential to deliver suitable surfaces whilst avoiding these problems.

Electrochemical polishing is not a very selective process and requires additional steps to provide selective processing, if a different surface finish is required on different areas of the manufactured part. Mechanical polishing, meanwhile, is hard to achieve and automate on 3D free form surfaces and is hence typically a long, labour intensive process. Laser based polishing is based on scanning the laser beam across the surface and melting a thin layer of material. Molten material flows over the surface smoothing its features in the process. It is quite insensitive to surface form and so can be easily automated. It is also reasonably quick, whilst being highly selective, thus it is suitable for applications such as dental implants where both rough and smooth surface areas are required.

In this presentation we focus on cw laser polishing of both curved and flat cobalt-chrome CoCr and titanium alloy Ti-6Al-4V AM parts. Many different scanning patterns, scanning speeds and line overlaps were tested. An improvement of both surface roughness and waviness of >90% in all cases is demonstrated. Residual stress is introduced by the laser polishing process but we show that this can be relieved by a standard heat treatment process.