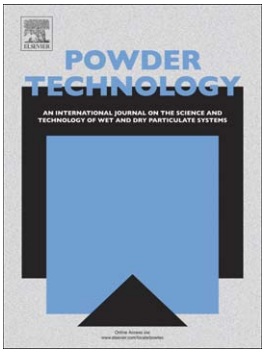

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Nicholas Clark, Nick Jones, Rossitza Setchi, Adrian Porch

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Particle Size Characterisation of Metals Powders for Additive Manufacturing Using a Microwave Sensor

Nicholas Clark[1c], Nick Jones[2], Rossitza Setchi[1], Adrian Porch[1]

[1] School of Engineering, Cardiff University, The Parade, Cardiff, UK, CF24 3AA

clarkns@cardiff.ac.uk, setchi@cardiff.ac.uk, porcha@cardiff.ac.uk

[2] Renishaw Plc, New Mills, Wotton-under-Edge, UK GL12 8JR

nick.jones@renishaw.com

[c] corresponding author (Tel: +447854321562)

The production of high-value and high-quality metal parts with complex interior structures is enabled by the use of Additive Manufacturing (AM) techniques, which use metal powders with repeatable characteristics. Of these characteristics, particle size distribution is a key factor. This paper describes a particle size sensor based on a microwave cavity. It works on the principle that the magnetic permeability of metallic powders at microwave frequencies depends strongly on the particle size distribution of the powder owing to the classical skin effect. The sensor's capability is demonstrated by measurement of the permeability of a range of Ti6Al4V alloy powders with different particle size distributions. Permeability is shown to be congruent generally with the existing theory. The reduced imaginary permeability compared with the theoretical case observed for larger particle sizes is shown to be consistent with simulation. The method is also demonstrated to be highly precise, able to detect changes of less than 0.1µm for particles of average radii of approximately 11.7µm. Increases in sensitivity are possible by optimising the sensor design so that it operates in the regime where the permeability changes most rapidly as a function of particle size.

Keywords – Additive manufacturing, microwave, cavity, perturbation, permeability, powder, titanium