NEW TYPE OF METAL PARTICLE DOSING, TRANSPORTATION AND POSITIONING SYSTEM

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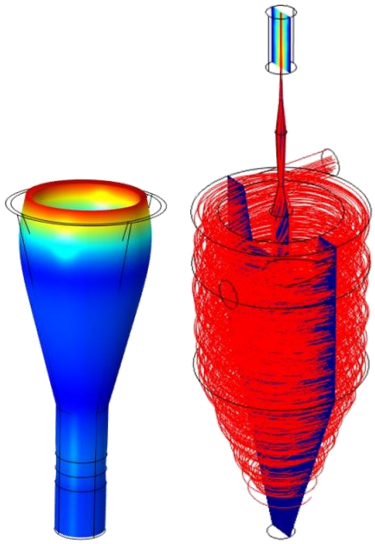
Laser metal deposition (LMD) technology is an additive manufacturing technique, which allows producing metal parts characterized by good metallurgical properties using an extremely low consumption of the metal powder. Therefore, LMD has been of most interest in high value added applications such as in aerospace and medicine which can afford this developing process as a whole, in spite of the criticality of performance and acceptance criteria in these industry sectors [1].

However, one of the major disadvantages of this process is the relatively low melt pool resolution and repeatability of particle tracing which have impact on the surface roughness. Although surface roughness can be improved using melt pool and layer thickness, but this has an impact on a slow production turnaround. Relatively low efficiency of the trapped powder, which can be less than 5% in some cases, is an additional drawback of this technology in our days. The main goal is to design a novel high definition (HD) Head for LMD process with low particle dispersion.

Our proposed HD-Head consists of an ultrasonic actuator of tulip type, a mixing chamber and an outlet tube. The ultrasonic actuator generates the acoustic pressure field in local volume zone (Fig. 1a). Special geometry of the mixing chamber creates aerodynamic conditions for tornado appliers (Fig. 1b). The tornado allows transporting particles from the walls of the actuator to the centerline of the HD-Head. The centerline of the HD-Head contains the highest particle concentration; thus the outlet tube is positioned in this area. Collected particles pass though the outlet tube and enter the de Laval tube, where they are accelerated and form a precise particle beam with low dispersion. Analysis of the novel dosing, transportation and positioning system for LMD process was conducted using COMSOL Multiphysics software.



a) b)

Fig. 1. Microstructural evolution of additively manufactured parts

[1] C. Selcuk, S. Bond, P. Woollin, Joining processes for powder metallurgy parts: a review, Powder Metallurgy, 53:1, 7-11 (2010).