Title: Study and modeling of an atomizer for the production of metal powders

Missions / Activities

The metal additive manufacturing (AM) market has been on the rise for several years, particularly for the aeronautic, medical, automotive sector…, enhancing the need of metal powders with specific particle size distributions and of good quality (spherical, without porosity, of homogeneous chemical composition and without pollution). Among the several atomization technologies that have emerged in recent decades for the production of metal powders, the EIGA (Electrode Induction melting Gas Atomization) process is particularly appealing. This process allows atomizing so-called "reactive" alloys such as titanium alloys, thanks to induction melting without crucible, which limits or even eliminates any pollution linked to the process.

Today, the yields of the EIGA process for the particle size range dedicated to laser powder bed fusion, the most widely used AM process, are too limited, and result in production costs for fine powder (<45 or 63 µm) too high. Optimizations are possible by adjusting the parameters of the atomization gas (pressure and inlet flowrate). The tests carried out on the EIGA platform confirm indeed the preponderant role played by these operating parameters. However, these tests do not allow understanding in detail the influence of each of the parameters and the consequences on the characteristics of the powders. The use of numerical simulation, in particular the detailed description of the compressible gas flow, seems an essential upstream step to allow the best optimization of powder production.

Different process control strategies will thus be evaluated for industrial applications. The approach adopted within this project breaks down into 3 interdependent parts. The first part is the modeling of the nozzle in real geometry with the gas parameters, to which will be added in a second part a description of the behavior of the liquid metal in order to study the metal / gas interactions and the fragmentation of the liquid metal. For each of those two parts, the results of the modeling will be compared with experimental observations using a high-speed camera to validate the hypotheses of the physical models introduced. A literature survey will accompany the different parts of the project.

Work context

The IJL and LEMTA laboratories located in Nancy (France) will supervise the post-doctoral fellow who will be responsible for the modeling work. The atomization experiments will be carried out at MetaFensch in Uckange (France).

The Jean Lamour Institute (IJL) is a laboratory of more than 500 people from the University of Lorraine and the CNRS, multi-thematic in the science and engineering of materials and processes. The "Process Metallurgy" research group has extensive experience in mathematical modeling and numerical simulation of pyrometallurgical processes, without neglecting the experimental component. "Full-scale" experimentation, on an industrial site, is often an originality of the group approach. A large part of the studies are carried out in collaboration with industrial users of the production processes.

The Laboratory of Energetics, Theoretical and Applied Mechanics (LEMTA) is a laboratory of more than 160 people from the University of Lorraine and the CNRS, which contributes to creating new knowledge in the field of science for engineers. Among the many specialties, the "Transfers in Fluids" research group is interested in heat and mass transfers between flowing liquid droplets, a gas and / or a solid wall by addressing the couplings between hydrodynamics, transfer phenomena and phase changes. (evaporation, solidification).

Candidate

The candidate must hold a PhD thesis in Fluid Mechanics and Energy or more generally in Engineering Science with solid skills in CFD (Computational Fluid Dynamics). The candidate must be motivated to

discover and contribute to deepen the knowledge of atomization mechanisms and participate in the experiments. The appointment is for 12 months. The annual salary will be from 37,000 Euros to 38,000 Euros before tax.

Your complete application (CV, cover letter and contact information of 2 references) should be sent to:

- IJL: Jean-Pierre BELLOT – jean-pierre.bellot@univ-lorraine.fr
Pierre CHAPELLE – pierre.chapelle@univ-lorraine.fr
- LEMTA : Nicolas RIMBERT – nicolas.rimbert@univ-lorraine.fr