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MECHANICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

DESIGN OF A SUPERSONIC NOZZLE FOR A COLD NANOPARTICLE DEPOSITION

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by

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ABSTRACT

This project comprises an investigation of the requisite design and operational characteristics of a supersonic nozzle. Gaseous flows through such nozzles are forced to obtain supersonic speeds that can also be imparted to solid particles that are carried along by the flow. Such speeds can enhance the adherence of these particles on a solid substrate without loss of their characteristic properties.

The aforementioned process can be used when the properties of the substrate need to be improved. If the deposition process is performed properly, it is possible to achieve surface properties similar to those of the powder being used. Even though this method is used nowadays in industry several operational improvements are needed for better results.

For the design of the nozzle two main pieces of information are required: the governing equations that characterize a particular gaseous flow through the nozzle coupled with the design parameters that typify the manufacture of the nozzle. If the information is thoroughly documented and properly understood then the nozzle can be properly designed, manufactured and used for the purpose stated above.

The relevant theory for supersonic nozzles was obtained by studying the characteristic behavior of compressible flow. An in-depth theoretical understanding of the process was a prerequisite prior to the evaluation of any design and operational parameters. The design options were evaluated against the actual apparatus that is used nowadays in industry and is available in the form of various patents.

A thorough manipulation of the design parameters in relation to the flow characteristics was performed and a representative design has been proposed.

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