WIRE ADDITIVE MANUFACTURING: APPROACH BY INDUCTION HEATING

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Support from an industrial collaborative
project with Eder company.

Abstract

A novel approach of wire deposition using inductive energy for additive manufacturing applications is presented.

In this approach :
- No storage of the molten material.
- Wire is melted by an induction heating system.

To demonstrate the potential of this approach, a numerical model has been developed, and validated experimentally.
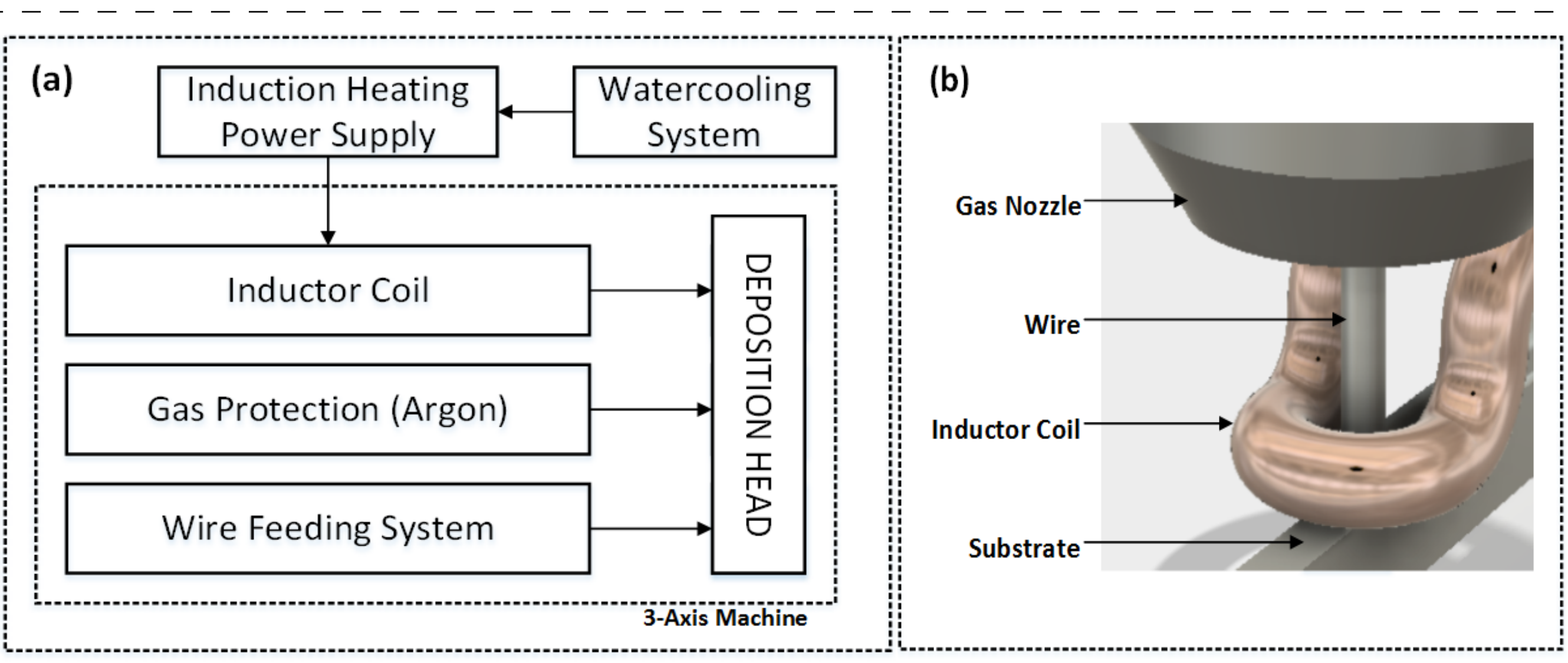
Global description (a) and details (b) of the deposition head

The Proposed Approach

The procedure for producing the layer consists of the following steps:
(1) Pre-heating of the substrate
(2) The wire is introducing to be melted with the substrate.
(3) The wire feeding speed (WFs) and the travel speed (Ts) are set.

Approach Validation by numerical simulation and experimentals results
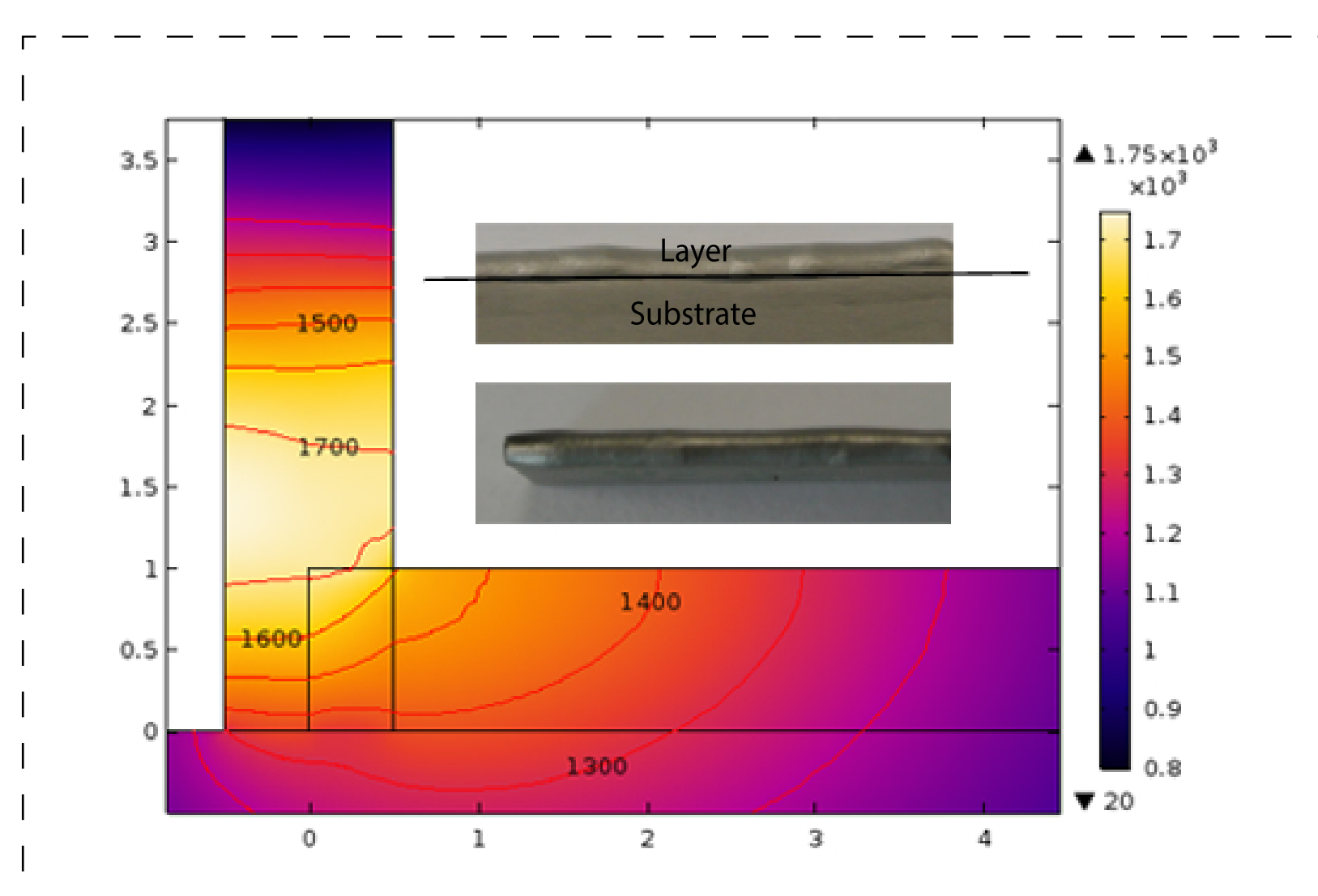
Thermal iso-values (°C) and corresponding result at Ts 90 mm/min, Wfs 110 mm/min
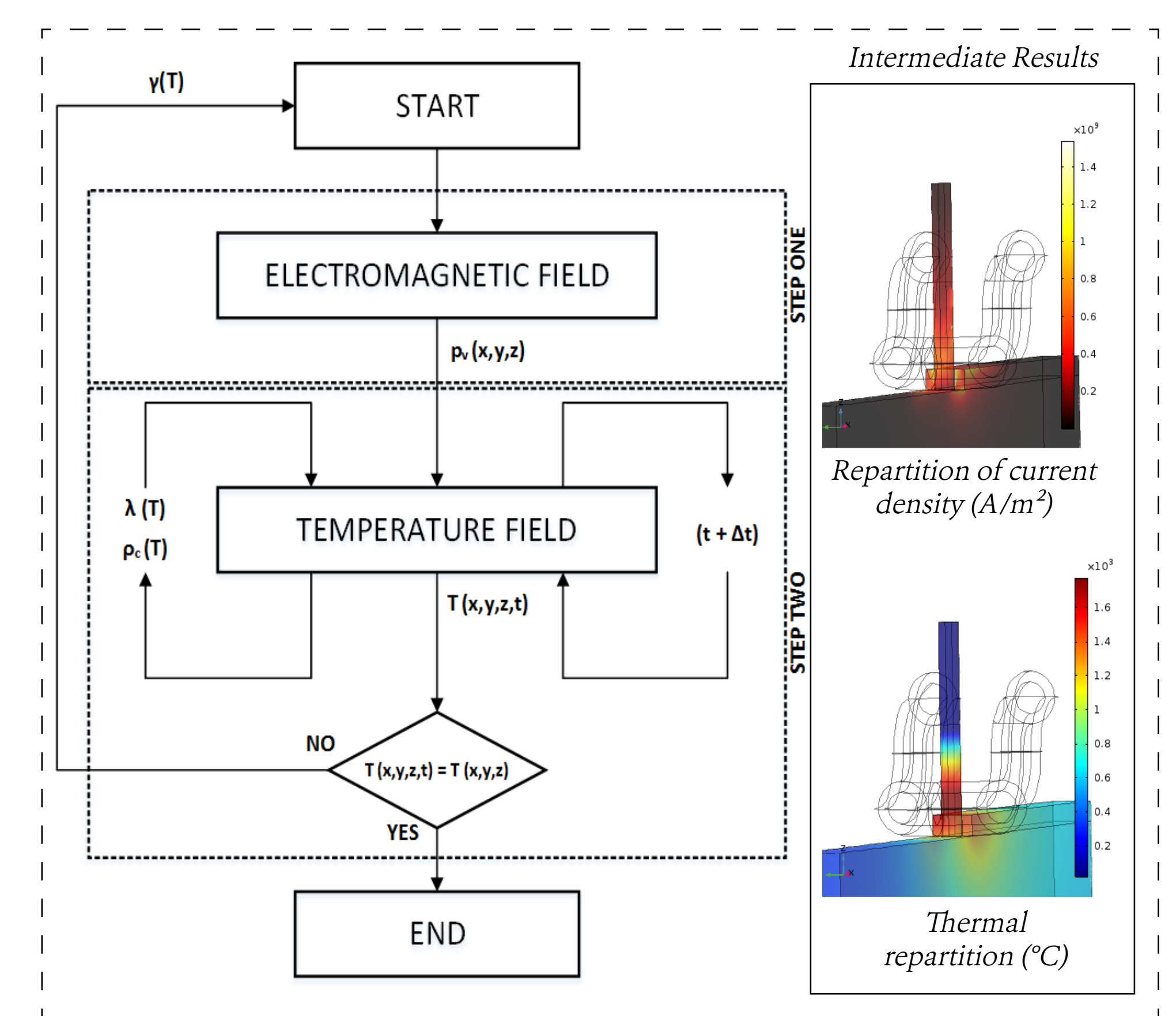
Experimental Validations
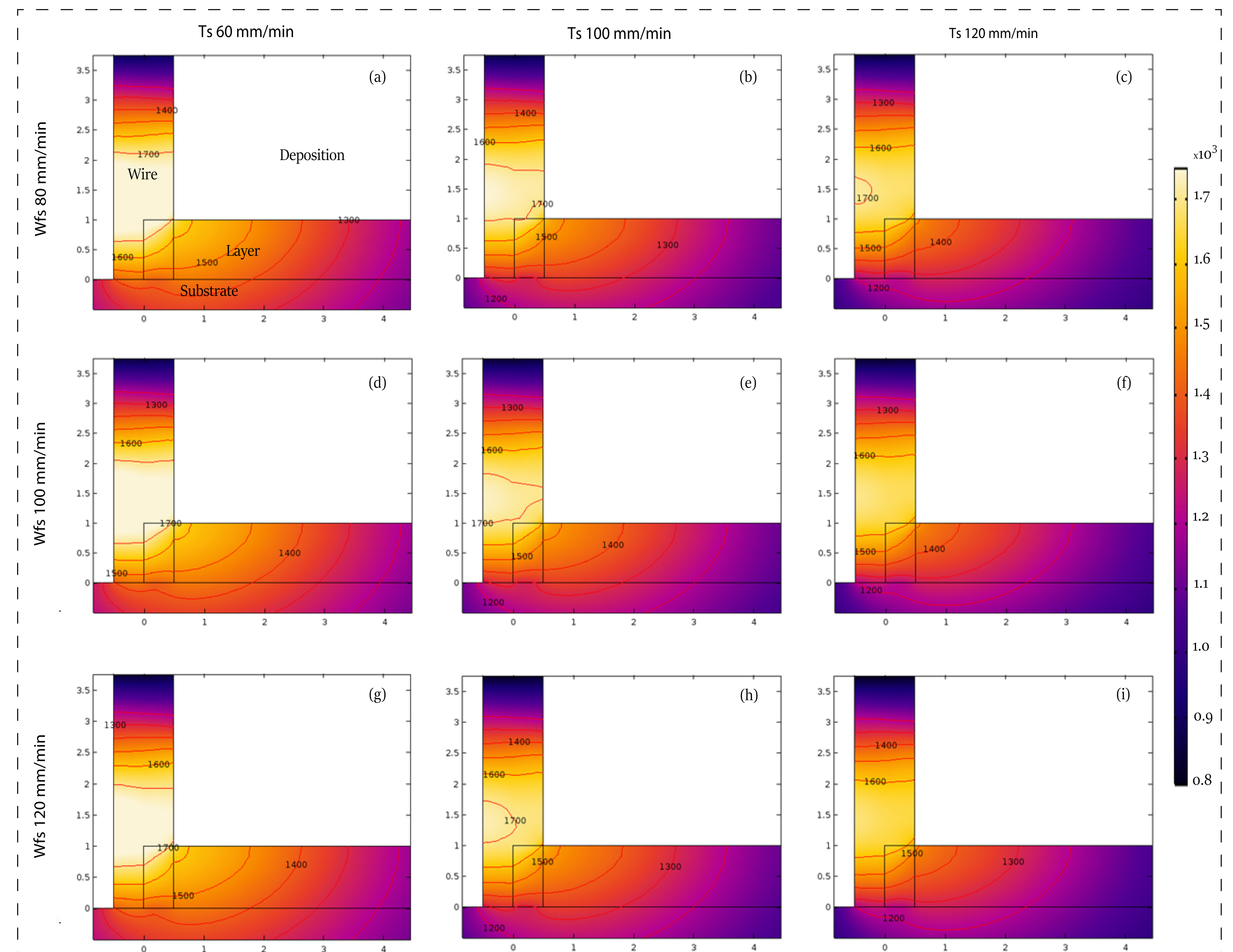
Thermal evolution (°C) during the deposition for different travel speed and wire feeding speed

Numerical simulation for optimised parameters determination

Numerical Model

Algorithm of calculation

Experimental validation for optimised parameters determined using numerical model

All the analysis is made with stainless steel 316L wire (0.8 mm)

The thermal losses – radiation, convection and conduction – in the substrate and the wire are included in the numerical model

Concluding remarks :

The approach deals with magnetic fields created by an inductive source in a wire additive manufacturing context.
The manufacturing apparatus is already designed and the first experimental tests give interesting results.

The next steps will be to experiment and to propose a multi layer deposition model with an energical optimisation to show the approach's potential.