

# Study of the effect of carbon contamination on the consolidation of an iron-based alloy by Field Assisted Hot Pressing (FAHP). Proposal to suppress the microstructural anisotropy generated.

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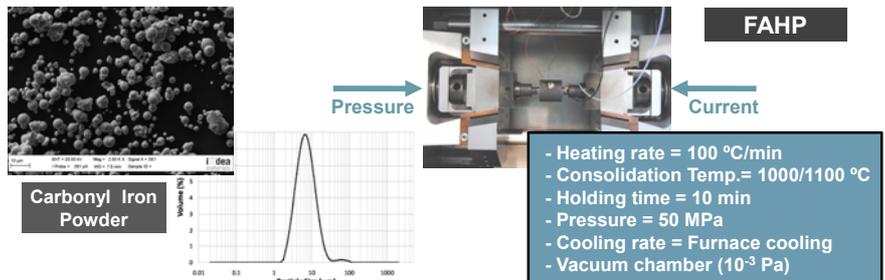
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**Objective:** A spherical carbonyl iron powder is consolidated at two temperatures, both above the austenitizing temperature, to analyze the carbon contamination coming from the graphite tools used during sintering by FAHP. A processing route using tungsten foils instead of graphite foils is evaluated to avoid the carbon diffusion through the iron matrix.

**Introduction:** In the last decade, powder consolidation methods using electric current and applied external pressure have been widely investigated due to their possibility of sintering a large range of materials, in short processing times and few processing steps, with reasonably high densities and avoiding undesirable grain growths<sup>1-3</sup>.

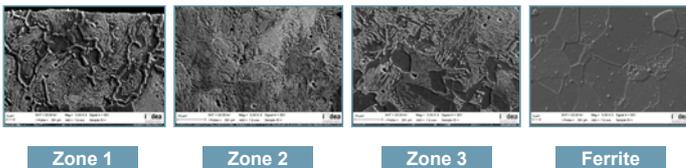
**Experimental:** The powder was consolidated in a Gleeble 3800 equipment and poured into a cylindrical graphite die.



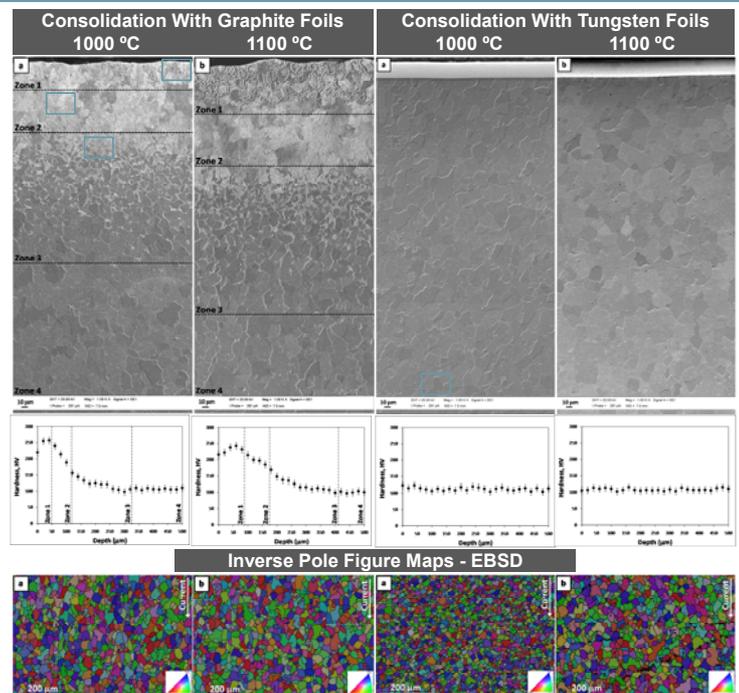
## Results:

After consolidation using graphite foils, the microstructure of the iron-based alloys is heterogeneous, exhibiting a compositional gradient in carbon.

**Zone 1:** Hypereutectoid microstructure (Cementite and Pearlite). **Zone 2:** Eutectoid microstructure (Pearlite). **Zone 3:** Hypoeutectoid microstructure (Pearlite and Ferrite). **Zone 4:** Ferrite.



After consolidation with high purity tungsten foils, the microstructure of the iron-based alloys is homogeneous and fully ferritic.



## Summary:

- The use of thin graphite foils during FAHP leads to microstructural anisotropies.
- The increase of the temperature raises the depth of the areas enriched in carbon.
- The replacement of the graphite foils by tungsten foils inhibits the introduction of carbon in the consolidated samples and refines the final grain size.
- FAHP does not induce any texture during the processing routes analyzed in this investigation.

1. R. Orrù, R. Licheri, A.M. Locci, A. Cincotti, G. Cao: "Consolidation/synthesis of materials by electric current activated/assisted sintering", Materials Science and Engineering R, 63 (2009) 127-287.

2. S. Grasso, Y. Sakka, G. Malzza: "Electric current activated/assisted sintering (ECAS): a review of patents 1906-2008", Science and Technology of Advanced Materials, 10 (2009) 1-24.

3. D.V. Quach, J.R. Groza, A. Zavaliangos, U. Anselmi-Tamburini: "10 - Fundamentals and applications of field/current assisted sintering", Woodhead Publishing Series in Metals and Surface Engineering,(2010) 249-274.