Abnormal grain growth in pure iron during SPS in presence of a PVD carbon diffusion barrier.

Romain Charvet, Université Bourgogne Europe, CNRS, Laboratoire Interdisciplinaire Carnot de Bourgogne ICB UMR 6303, F-21000 Dijon, France

Maria-Rosa Ardigo-Besnard, Université Bourgogne Europe, CNRS, Laboratoire Interdisciplinaire Carnot de Bourgogne ICB UMR 6303, F-21000 Dijon, France

Frédéric Bernard, Université Bourgogne Europe, CNRS, Laboratoire Interdisciplinaire Carnot de Bourgogne ICB UMR 6303, F-21000 Dijon, France

Aurélien Besnard, Université Marie et Louis Pasteur, SUPMICROTECH, CNRS, institut FEMTO-ST, Besançon, France

Yoann Pinot, Arts et Metiers Institute of Technology, LaBoMaP, Cluny, France

The elaboration of metallic parts by powder metallurgy techniques such as SPS, represents a relevant alternative to conventional manufacturing processes. This allows the elaboration in a single stage of dense and high-performance materials with high mechanical properties. One of the major problems during SPS of metallic powders is the carbon diffusion from the graphite tooling, and/or from the graphite foils inserted between the powder and the tools, to the powder. This carburization can lead to a degradation of the sintered material properties and to the formation of a surface composition gradients. Up to now, only few studies addressed this issue.

In a previous work, it has been demonstrated that a titanium coating (about 1 µm thick) deposited by Physical Vapor Deposition (PVD) on the graphite foil was efficient in avoiding carburization of pure iron during sintering. This minimal thickness was established based on thermodynamic simulations performed using ThermoCalc® DICTRA.

In the present study, an abnormal grain growth was observed when using thicker coatings were used, leading to the appearance of large columnar and equiaxial grains. The mechanisms underlying this phenomenon were investigated using SEM-EBSD and through variations in processing conditions to better understand this behavior.

This study was performed in the frame of the ANR OEDIPUS project (ANR-23-CE08-0028).