

Functionalization of Spark Plasma Sintering components by Physical Vapor Deposition

B. Nano-engineered coatings and thin films: from design to applications

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Abstract

Powder metallurgy processes, like Spark Plasma Sintering (SPS), allows to obtain metal parts with a fine and homogeneous microstructure and improved properties. In this process, the sintering is obtained by the simultaneous application of a pulsed current, making it possible to heat the powder, and of a uniaxial pressure. The powder is isolated from direct contact with the graphite tooling (mould, punches) by a sheet of graphite. Two issues can be identified: first, the carbon contamination of the powder leading to the formation of highly carburized layers on the surface, or even to the diffusion of carbon at the grain boundaries deeper in the part, and second, the bulk composition is dependent of the one of the initial powder.

In order to solve the contamination issue, one may apply by PVD of a thin protective layer on the graphite sheet. Indeed, magnetron sputtering makes it possible to produce films with a particular stoichiometry (from single element to multi elements alloys), having a controlled thickness and covering the graphite sheet in a homogeneous and conforming manner.

Secondly, coating the powder particles can also allow tuning finely the composition of the base powder. It paves the way to the synthesis of alloy with specific phase composition and improved properties thanks to the very fine microstructure.

In this study, part of the project OEDIPUS ANR-23-CE08-0028, these two approaches are applied to the sintering of iron-based powders.