

UNIVERSITY: Lille , Faculty of Sciences and Technologies

Scientific field: Chemistry / anti-oxidation protections

Title of the thesis: Innovative anti-oxidation protections for isostatic graphite

Supervisor(s): François Méar / Lionel Montagne / Philippe Meunier (Mersen)

Laboratory: UCCS / CS / RM2I – UMR 8181

Related research project (international/national/regional):

Expected/obtained funding: CIFRE funding

ABSTRACT

Mersen is a world specialist in high performance graphite products and in particular a world leader in the field of isostatic graphite. Mersen markets products and solutions for various industries in the energy, transport and aeronautics, chemical and electronics industries. Graphite can be used in high and very high temperature applications under an inert atmosphere (up to 3000°C), but under an oxidizing atmosphere the graphite oxidizes from 450°C and then loses its interest.

Among Mersen's major customers, civil aeronautics is today increasingly encouraged, even obliged, to reduce its greenhouse gas emissions, in particular to follow up on commitments made at COP25 and to face to the emergency caused by global warming. This reduction in emissions involves improving the efficiency of aircraft engines, and therefore increasing the combustion temperature. All the parts present in the engines must accompany this tendency and be able to resist higher temperatures. It is therefore essential to have solutions to protect carbonaceous materials from oxidation.

Mersen has already developed anti-oxidation solutions which allow graphite to be used up to 550°C. To protect graphite from oxidation, the solution used is the impregnation in the mass of carbonaceous materials with an aluminum phosphate solution, followed by baking at high temperature.

The objective of the thesis is to contribute to extending the field of protection against oxidation towards higher temperatures. For this, a study of the thermal transformations of the components of the protection will be carried out by means of advanced characterization techniques, in particular the NMR of solids which makes it possible to detect amorphous phases and in minor quantity. A second approach will aim to change the composition of the protection and the application heat treatments.

The student will make regular stays in the company, first to acquire the implementation methods used by the company, then to apply the processes developed in the laboratory. He / she will have access to all of the UCCS's characterization methods, which include in particular electron microscopy, electron microprobe, X-ray diffraction, thermal analyzes, surface analyzes, and especially NMR which constitutes a specificity of the RM2I team of the UCCS. He and she will benefit from training on all of these characterization means, in particular with regard to solid state NMR. He and she will thus have the opportunity to train in the management of an industrial problem by a scientific approach using the most modern characterization means.

Planned recruitment date: 01 November 2020

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Additional remarks/comments: