Postdoc- Offer - CEMEF

TITLE	***Grain size control during solutioning after forging of a powder metallurgy nickel base superalloy***
Global objective of work	The objective of this work is to unravel the physical mechanisms by which overgrown grains can develop during solutioning after forging in a new powder metallurgy nickel base superalloy. The alloy is aimed at being used in the manufacture of critical turbojet engine components, which implies fulfilling very strict metallurgical specifications. The use of such alloys enables the operating temperature (and in turn energetic efficiency) of the engine to be raised and thus enables fuel consumption savings, with positive impact from the energetic and ecological point of views.
Context	The work is funded by a world leading aircraft engine manufacturing company and will be carried out at Cemef, a research lab of the MINES Paris engineering school located in Sophia Antipolis (French riviera), that has great experience in the field.
Detailed presentation with figure(s)	The solutioning treatment performed after forging aims at dissolving γ'-phase precipitates so that they can be formed again during subsequent controlled cooling to achieve optimal mechanical performances. During solutioning, grains become free to grow as the pinning force exerted by the dissolving precipitates vanish. In powder metallurgy alloys, grain growth is nevertheless usually limited by the presence of very small oxide particles at the so-called PPBs (prior particle boundaries, meaning the boundaries between the initial alloy powder particles). Under some circumstances, few grains are observed to grow to a very large extent (up to millimetric sizes, see the micrograph below), whereas the others stay in a typical 20-40 µm range. The aim of this work is to describe the metallurgical mechanisms leading to such very large grains and their dependency on the local thermomechanical history undergone while forging the piece.

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	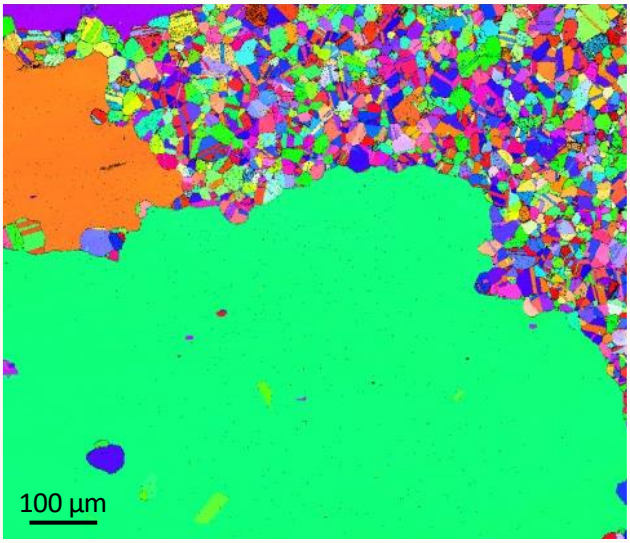
Tools	*Advanced experimental equipment for microstructure characterization (SEM based, including 3D analyses and the possibility of in-situ heating experiments, and TEM based) as well as advanced numerical simulation tools (https://consortium-digimu.cemef.minesparis.psl.eu/) will be available for this work.*
Key-words	Physical metallurgy, Recrystallization and Grain Growth, Nickel based superalloy, Experiments and Modelling
Skills, abilities requested	Degree : PhD in Materials Science or Physical Metallurgy Skills : Experimental work, modelling and simulation, proficiency in English and ability to work within a multi-disciplinary team.
Location	CEMEF, MINES Paris, 1 rue Claude Daunesse, 06904 Sophia Antipolis, France
Salary	3076 € (gross salary) ; about 2450 € after taxes
CEMEF team(s)	MSR group https://www.cemef.minesparis.psl.eu/en/presentation/metallurgie-structure-rheology-msr/
Supervisor(s)	Pr. Nathalie BOZZOLO nathalie.bozzolo@minesparis.psl.eu and Pr. Marc BERNACKI marc.bernacki@minesparis.psl.eu
Starting date	Expected to be April 2023, but could be postponed by a few months depending on the candidate's availability
Duration	Two years

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Application	CV and motivation letter PhD thesis reviewing reports References and/or recommendation letters

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