

**RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM**  
**(one page maximum)**

**Field:** *Materials Science, Mechanics, Fluids*

**Subfield:** Materials Science & Engineering

**Title:** Improvement of surface properties by PVD-Thermochemistry hybrid treatment on metal substrates obtained by conventional manufacturing processes and by powder metallurgy

**ParisTech School:** Arts et Métiers Sciences et Technologies

**Advisor(s) Name:** NOUVEAU Corinne

**Advisor(s) Email:** [corinne.nouveau@ensam.eu](mailto:corinne.nouveau@ensam.eu)

**Research group/Lab:** Materials and Surface Engineering Team / Laboratoire Bourguignon des Matériaux et Procédés (LaBoMaP)

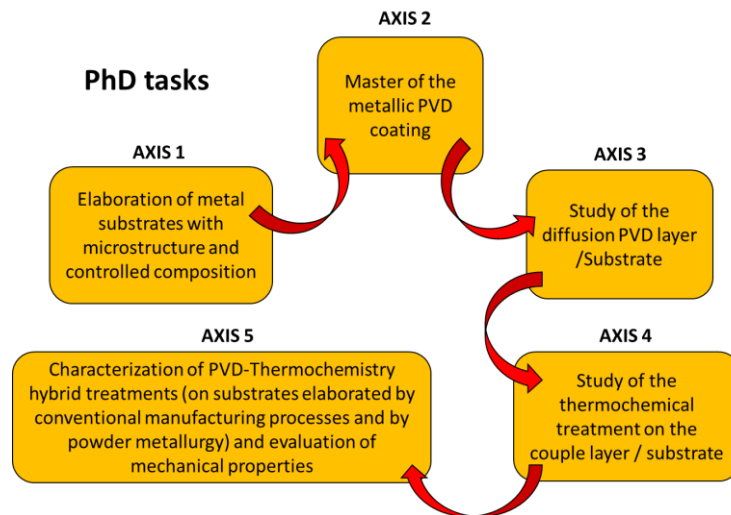
**Lab location:** Cluny, FRANCE

**(Lab/Advisor website):** [labomap.ensam.eu](http://labomap.ensam.eu)

**Short description of possible research topics for a PhD:** (10-15 lines in English + optional figure)

The LaBoMaP has a recognized expertise in vacuum treatment products, which are commonly used in numerous domains (transport, health, energy, etc.). The purpose is to improve the surface properties of the devices, in particular to protect them from severe solicitations (corrosion, abrasion, etc.). Both processes studied in the laboratory are Physical Vapor Deposition (PVD) and thermochemical treatments under vacuum, as well as their combination or "hybrid treatments". The aim is to thermochemically treat PVD metallic coatings (such as Cr, Ti..) to convert them in binary compounds (CrN, TiC etc). The objective of this PhD will be to master the numerous parameters that can influence both processes, to obtain the hard surface layer and the adequate gradient of hardness for its mechanical strength. First, substrates obtained by conventional manufacturing processes (forging, rolling) will be used. Then, the same substrates will be elaborated by metal powders in ICB laboratory (University of Burgundy, Dijon), having a reputed expertise in this field, by Spark Plasma Sintering (SPS) and the Hot Isostatic Pressing (HIP).

The project will be organized in 5 axes according to the following figure:



**Required background of the student:** (What should be the main field of study of the applicant before applying?)

1. A master's degree in materials science (knowledge in metallurgy, surface treatments, diffusion, characterizations techniques such as SEM, XRD, EBSD etc).
2. Ability to work independently, to plan and carry out tasks, and to be a part of a large, dynamical group.
3. Good communication skills in English and/or French, both written and spoken.
4. Experience with powder metallurgy is an advantage but not an exclusion criterion.

**A list of 5 (max.) representative publications of the group:** (Related to the research topic)

1. Influence of Substrate Bias Voltage on Corrosion and Wear Behavior of Physical Vapor Deposition CrN Coatings, Aouadi, K., Tlili, B., **Nouveau, C.**, ...Chafra, M., Souli, R., Journal of Materials Engineering and Performance, 2019, 28(5), pp. 2881-2891
2. Low-temperature plasma nitriding of martensitic stainless steel, Rao, K.R.M., **Nouveau, C.**, Trinadh, K., Transactions of the Indian Institute of Metals, 2020, 73(6), pp. 1695-1699
3. Thermal treatment effect on structural and mechanical properties of Cr-C coatings, Fellah, M., Aissani, L., Zairi, A., ...Montagne, A., Iost, A., Transactions of the Institute of Metal Finishing, 2018, 96(2), pp. 79-85
4. A study of the tribological behavior of duplex treatment, Siad A., **Nouveau C.**, Besnard A., Jacquet P, Annales de Chimie - Science Des Matériaux, 2015, 39(3-4), pp. 201-208
5. Influence of the process parameters on the microstructure of a hardfacing coating elaborated by hot isostatic pressing, Tellier, A., **Ardigo-Besnard, M.R.**, Chateau-Cornu, J.-P., Archives of Metallurgy and Materials, 2019, 64(1), pp. 33-38