Post-doc in "AI and Image Generation applied to 3D Materials" - 18-month fixed-term contract potentially renewable 1 time
Centre SPIN – Mines Saint-Etienne

Context

The École Nationale Supérieure des Mines de Saint-Étienne (Mines Saint-Etienne), part of the Institut Mines Télécom (IMT), under the supervision of the French Ministry of the Economy and Finance, is responsible for training, research and innovation, transfer to industry and scientific, technical and industrial culture. Mines Saint-Etienne represents: 2,400 student-engineers and researchers, 480 staff, a consolidated budget of €46 million, 3 sites on the Saint-Etienne campus (Loire) of around 26,000 m², a Georges Charpak Provence campus in Gardanne (Bouches-du-Rhône) of around 20,000 m², 6 research units, 5 training and research centers, a center for scientific, technical and industrial culture (La Rotonde). Mines Saint-Etienne has development projects in Lyon, notably on the Campus Numérique of the Auvergne-Rhône-Alpes region, and numerous international collaborations.

The Georges Friedel Laboratory (LGF) is a CNRS Joint Research Unit (UMR 5307) and belongs to the Institute of Engineering and Systems Sciences (INSIS). Located at the École des Mines de Saint-Étienne and supported by two trusts (Mines Saint-Étienne and CNRS), the laboratory brings together all the research potential of Mines Saint-Étienne in the fields of materials, mechanics and processes.

The "Sciences des Processus Industriels et Naturels" (SPIN) center is a research, teaching and technology transfer center renowned for its expertise in Process Engineering applied to divided solids (grains, pores, particles, powders, soils, ores). As part of the Georges Friedel Laboratory (UMR CNRS 5307), it applies its scientific skills and cutting-edge equipment to drive innovation in industrial companies faced with the energy transition and the need to invent new, high-performance processes and materials. The SPIN center is structured into three departments and six research themes: powder technology, geometry and physical chemistry of granular media, complex hydro-systems and geo-processes, industrial crystallization and application of gas hydrates, reactivity and transformation of solids, and electrical properties of solids interacting with gas and instrumentation.

The successful candidate will be integrated into the SPIN center and the LGF laboratory.

The theme we wish to support and strengthen is "AI and Image Generation", particularly for the study of 3D materials (see Figure 1); it forms part of the wider field of mathematics applied to Process and Materials Engineering. Over the last ten years or so, the SPIN team has seized the digital simulation niche to meet the growing industrial need to control granular processes as well as conventional ones. The challenge we are tackling is to develop original models that can be used to digitally simulate 3D materials by AI and image analysis that possess the best physico-chemical properties (Materials by Design). The development of these digital twins will lead companies to take full advantage of the digital transition to develop high-performance processes and materials, and thus enter the industry of the future.

To help achieve this highly ambitious goal, Mines Saint-Etienne is recruiting a post-doc in "AI and Image Generation applied to 3D Materials", to mainly work on the CELCER-EHT project (see below).

1. General context of the project

The CELCER-EHT project aims at developing High Temperature Electrolysis (HTE) based on Solid Oxide Cells (SOCs) offering performance and durability levels. These targets, included in the French and European roadmaps, condition the commercialization of HTE and position the CELCER-EHT project in direct response to priority 1 of the National Hydrogen Plan: "decarbonize the industry" by emerging a French electrolysis industry.

The research strategy to achieve these ambitious goals is focused on the development of materials and processes and is divided into two phases. In the short term, the project aims to make the most of today's most promising cell materials (Ni-YSZ cermet, doped zirconia and perovskite-type oxides) by optimizing their compositions, microstructures and interfaces. In the longer term, the research focuses on the development of new cell materials (e.g., doped ceria, nickelates and decomposition products), new microstructures (e.g., core-shell powders, functionalized interfaces, texturing) and on their implementation in a completely new cell.

2. Objectives and missions

In this general context, the objective of this postdoctoral work is to model and characterize the micro-structure of SOCs by using tools from AI and image synthesis. Previous works have been done on spatially homogeneous structures [3-8]. Nevertheless, the degradation phenomena of the cells over time can lead to the appearance of heterogeneity within the micro-structure with the appearance of a phase gradient. We will therefore try to create a flexible micro-structure model, and then to fit it to real data after an optimization process.

Finally, we will explore the possibility of adding a temporal component [1,2] to our model in order to take into account the deterioration of the micro-structure and the evolution of the characteristics of the environment.

The development of such a model should allow in fine to produce a realistic microstructure whose characteristics (volume fraction, surface density and triple points, etc.) would be defined by the user. This would then lead to a large number of virtual micro-structures, allowing to find the optimal microstructure that will improve the performance and durability of the cells.

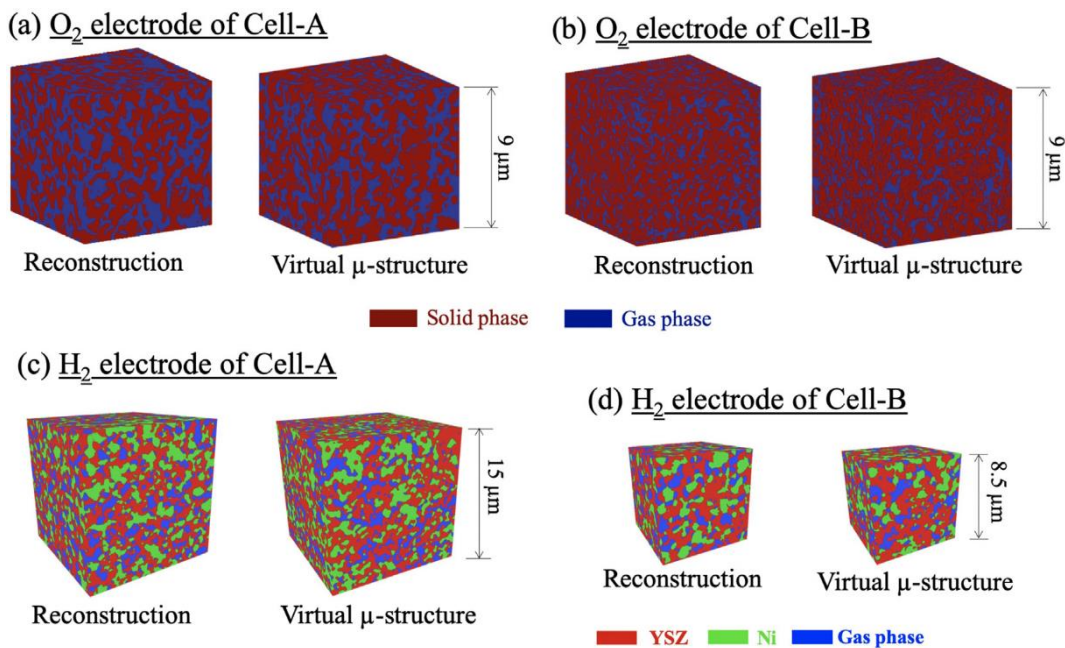Missions are likely to evolve according to the needs of the department and Mines Saint-Etienne.

Figure 1: Comparison between a synthetic micro-structure (from the model) and a reconstruction (real data) for the O_2 (a) and (b) and H_2 (c) and (d) electrodes from article [7].

The position will be based at Mines Saint-Etienne on Saint-Etienne Campus in France. The candidate will have the possibility to co-supervise Master and PhD students. Teaching assignments (in image analysis and/or AI) may also be entrusted to the person recruited.

3. Candidate profile

The person recruited will support and strengthen the "AI and Image Generation" theme, particularly applied to 3D materials. He/she should hold a PhD, typically in image analysis and/or artificial intelligence.

Post-doctoral experience, particularly abroad, will be appreciated. The candidate must demonstrate scientific competence in one or both of the following areas:

- Image analysis (processing, analysis, modeling)
- Artificial intelligence (GANs, diffusion models, deep learning…)

Proficiency in computer science (pytorch tensorflow, keras, opencv, matlab, C/C++) is also required.

4. Evaluation criteria

- Ability to strengthen the "AI and Image Generation" research theme
- Ability to integrate into the research team, center and laboratory project
- Scientific output: quality and number of publications in A-rank journals
- International experience
- Scientific skills described in section 3

5. Recruitment conditions

- 18-month post-doctoral contract, potentially renewable 1 time
- Remuneration according to the rules defined by the Institut Mines Télécom management framework,
- Category II - Job P - Post-doctoral according to the Management Framework
- Full time
- Position based in Saint-Etienne (42)
- Desired start date: March 1, 2024

6. Benefits

- 49 days annual leave (vacation + RTT)
- Public transport costs reimbursed up to 75% (subject to conditions)
- Sustainable mobility package
- Staff clubhouse (sports and cultural activities, CE benefits for leisure activities and social events)

7. How to apply

Applications (covering letter, detailed curriculum vitae and any other information deemed useful for examining the application) must be submitted no later than January 19, 2024 on the RECRUITEE platform.

https://institutminestelecom.recruitee.com/o/post-doc-in-ai-and-image-generation-applied-to-3d-materials-18-month-fixed-term-contract-potentially-renewable-1-time-2

Successful candidates will be interviewed between January 22, 2024 and February 2, 2024 (date to be confirmed).

As part of its Equality, Diversity and Inclusion policy, École des Mines de Saint Etienne is an employer committed to fair treatment of all applicants.

Positions offered for recruitment are open to all, with accommodations available on request for candidates with disabilities.

8. **To find out more**

For further information on the position, please contact:
- Jean-Michel HERRI, SPIN Center Manager : herri@emse.fr, +33 (0)4 77 42 02 92 - https://www.mines-stetienne.fr/recherche/5-centres-de-formation-et-de-recherche/sciences-des-processus-industriels-et-naturels/)
- Johan DEBAYLE, Project manager : debayle@emse.fr, +33 (0)4 77 42 02 19 - https://www.emse.fr/~debayle/index.html)

For administrative information, please contact:
- Charlotte MOGIER, human ressources administrator : charlotte.mogier@emse.fr, + 33 (0)4 77 42 01 18)

Useful links :
https://www.mines-stetienne.fr/
https://www.imt.fr/

 https://www.youtube.com/watch?v=QUeuC5iQiN0

Protecting your data :
https://www.mines-stetienne.fr/wp-content/uploads/2018/12/Informations-des-candidats-sur-les-traitements-de-donn%C3%A9es-personnelles.pdf