Ph.D offer

Title: Development of thin film membranes for Hydrogen separation

Abstract

The aim of the project is to develop functional thin films for hydrogen separation membranes. The functional layers will be prepared by means of atomic layer deposition (ALD) and spatial atomic layer deposition (SALD). ALD allows the preparation of high quality and conformal films onto porous substrates or other complex geometries. SALD is a novel approach to ALD that allows operation at atmospheric pressure, and with deposition rates which are orders of magnitude faster than conventional ALD. The project will imply the development of novel deposition processes for new nanomaterials, as well as their structural and functional characterization for membrane applications.

Project description

Functional thin films and nanolayers play an important role in many devices, from transistors to solar cells, and from batteries to membranes. Hydrogen is becoming a key element in the transition to a low carbon society and this requires optimization of the production and purification processes for its final use. New membrane design and/or new strategies for developing H_2-selective membranes on porous supports are urgently required, preferably with an extended temperature range for gas separation applications and ideally with a good resistance to carbon monoxide and other poisoning-compounds.

Atomic layer deposition (ALD) is a technology offering the possibility to prepare high quality thin films of functional materials onto high aspect ratio substrates with precise thickness control, high uniformity and excellent conformality. The latest is a unique capability offering the possibility of covering complex porous surfaces. Therefore, this route is particularly suited for the structural modification and pore tailoring of synthetic membranes.

In order for ALD to be competitive in this new membrane application, it has to be scalable. Functional nanolayers must be prepared at high speed over large and porous surface areas, at relatively low cost. Therefore, this project will also make use of SALD, a high throughput variant of ALD.

Working program

The main aim of the PhD will be to develop novel ALD processes and apply the benefits of the technique in various facets of membranes and membrane associated engineering processes. During the PhD, the candidate will develop ALD processes for the deposition of different materials for either physical or chemical hydrogen separation in a wide range of operative temperatures. The candidate will have access to state-of-the-art film metrology in order to evaluate the structural characterisation of the materials deposited. The candidate will benefit of the expertise of a leading research group in the SALD/ALD field.

Location

The candidate will be based at the Materials and Physical Engineering Laboratory (LMGP), a leading research laboratory in materials science and materials for biomedical engineering. The laboratory is a joint Research Unit (UMR 5628) of CNRS and Grenoble INP within the Grenoble

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Alpes University. The research will be conducted within the framework of ADEME and ANR projects, in close collaboration with other groups that are mainly situated in Grenoble and Montpellier.

See link for more details on the group: https://sites.google.com/site/workdmr/

Requirements:

We are looking for a Materials Scientist, Physicist or Engineer with a strong chemical and solid state background and aptitude for teamwork. Candidates interested and with expertise and background in nanoscience and nanotechnology and energy will be favored. Basic knowledge and experience on typical materials science techniques is necessary (AFM, SEM, XRD, etc). Candidates must be fluent in English, and have excellent presentation and writing skills.

Allowance

The allowance will be issued from an ADEME fellowship to complement the group own funding. The research will be partly carried out in the framework of an ANR project in collaboration with the European Institute of Membranes of Montpellier and the Air Liquide group.

References :

Atomic layer deposition for membranes: basics, challenges, and opportunities. M Weber et al, *Chemistry of Materials* 30 (21), 7368-7390 (2018)

Speeding up the unique assets of atomic layer deposition. D.Muñoz-Rojas et al, *Materials Today Chemistry*, 12, 96-120 (2019)

Copper surface-alloying of H_2-permeable Pd-based membrane for integration in Fischer–Tropsch synthesis reactors, F. Toldra-Reig et al, Journal of Membrane Science 619, 118516 (2021)

Applicaiton

Please send your application to David Muñoz-Rojas (david.munoz-rojas@grenoble-inp.fr) including an updated CV, a copy of your undergrad and Master marks and two references (contact details).

The selected candidate will be proposed for an ADEME fellowship (https://agirpourlatransition.ademe.fr/entreprises/dispositif-aide/20210105/aac-theses2021-17). If selected, the PhD will start **in October 2021**

Deadline for applications: 7 March 2021