PhD SCHOLARSHIP APPLICATION FORM 2016

ORGANISATION Business Division Business Area	**TECNALIA RESEARCH & INNOVATION** ENERGY AND ENVIRONMENT Materials for Energy and Environment
Scholarship location Province/Building	GIPUZKOA/Parque Científico y Tecnológico de Gipuzkoa - Mikeletegi Pasalekua, 2-Donostia-San Sebastian
Tutor	1. Margot Llosa 2. Oana David

SCHOLARSHIP DESCRIPTION

Title: Development of inorganic hollow fibers for gas separation

Brief Description of Scholarship:

In this project we propose to develop *new composite asymmetric dual-layer (selective and support layers) hollow fibers* chemically stable showing high mechanical and gas permeation performances using an inexpensive process, more resistant to aging and targeting the nitrogen and oxygen separation from air, CO_2 removal from natural and biogas and a more challenging application, the propylene/propane separation.

To achieve the objectives innovative techniques will be used:

a. Manufacturing of porous inorganic supports (metallic, ceramic or carbon) using a dry-wet spinning process followed by heat treatment.
b. Coating of selective layer (CMSM, metal or perovskite)
c. One step production of *composite asymmetric dual-layer (selective and support layers)* using a triple spinneret.
d. Preparation and characterization of composite CMSM selective layer containing two types of nanoparticles for increasing the permeation and selectivity respectively.
e. Preparation and characterization of composite carbon porous hollow fiber support containing inorganic fillers to increase the productivity and the mechanical properties.

Scholarship description:

The present research line has the aim to develop inorganic hollow fiber membranes for gas separation processes. Membrane separation processes have low energy requirement and low maintenance cost compared to conventional separation processes (such distillation, water scrubbing and adsorption). Inorganic membranes based on perovskite, metal or carbon molecular sieve (CMSM) have highly attractive gas permeation properties and have been considered as the next generation of membrane technology. They offer tunable structure for gas separation and

very high thermal and chemical stability. The huge energy and capital savings that membrane based technologies would have on gas purification, provided the motivation of this project.
In spite of such attractive properties inorganic membranes have not been industrially implemented due to poor mechanical properties.
This project targets to tackle these problems in a simple and innovative manufacturing process, developing a composite low cost dual-layer hollow fiber with high permeability and selectivity. The dual layer consists of a porous support (carbon, metallic or ceramic) and a selective thin top layer (CMSM, metallic or perovskite). The double layer structure will benefit from both: gas separation provided by the selective layer and mechanical stability provided by porous inorganic substructure.

The resulting membrane will have the following commercially attractive properties:
1. Simple and straightforward production process that will strongly reduce production time and costs,
2. Good mechanical stability given by the inorganic substructure,
3. High gas productivity and selectivity provided by the thin selective layer,
4. High packing density, i.e. high membrane area per unit volume ratio given by hollow fiber diameter < 500 µm,
5. Versatility, different materials can be used resulting in high variety of gas separation applications.

The PhD would be done in collaboration with the Technical University of Eindhoven under the co-supervision of Dr. Fausto Gallucci.

Requirements:

The PhD candidate shall meet the following requirements:

- Qualifications and Speciality: Materials Engineering, Chemical Engineering and Chemistry
- Languages: Fluent English
- IT skills: No special requirements.
- The following will be a plus: Master degree related to membrane separation.