CSC_Rouen_Burel 30/03/2020

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES ROUEN NORMANDIE

PBS Polymères Biopolymères Surfaces UMR 6270

New bloc-copolymers membrane for CO_2 separation

At the Paris climate conference (COP21) in December 2015, 195 countries adopted the first-ever universal, legally binding global climate deal. The agreement sets out a global action plan to limit global warming. Among the proposed solutions by scientists, one would be to capture carbone dioxide (CO_2) because it is one of main contributor of the global warming. In addition, CO_2 in biogas and natural gas must be removed because it reduces the calorific capacity of gases and the acidic property of CO_2 degrades the gas streams by corrosion phenomenon.

Several conventional techniques are used to solve these problems, like amine absorption, but these technologies suffer of their high cost (high capital and operating investment) and high carbon footprint. On contrary, the membrane technology is a more ecofriendly alternative, with low footprint, low capital and operational expenditures, does not involve phase changes or chemical additives, and is modular and easy to scale up. However, the membrane technologies have also some drawbacks such as decreasing performances (permeability and selectivity) with time and temperature. For these reasons, researchers works on the development of new generations of membranes.

Polymeric materials are the most used to prepare membrane, because they less expensive and easier to scale up than inorganic materials. The most used polymers for gas separation are cellulose acetate, polysulfone, polyimide, polycarbonate, and Pebax®. These last are bloc-copolymers that contain polyamide-6 (PA-6) or PA-12 hard segments that gives strong mechanical resistance to the material, and ethylene oxide (PEO) or polyethylene glycol (PEG) amorphous segment like that are able to induct strong interactions with CO_2. Consequently, these copolymers are widely studied for CO_2 separation.

The progresses in chemistry science suggest to synthesize new polymers. The project of thesis will investigate a new generation of bloc-copolymers. The preparation of new copolymers, semi-crystalline, with high molecular weight and with elevated separation properties (Robeson curves) and good mechanical properties is a scientific and industrial challenge.

For the thesis, two or three new copolymers will be synthesized. Segments having polar properties will be selected. Several grades of co-polymers depending on the percentage and nature for hard and flexible segments will be prepared. The microstructure, the mechanical and the thermal properties of these new materials will be studied. We will focus particularly the transport and sorption properties towards gases (N_2, O_2, CO_2 and CH_4) and the influences of water vapors on the properties. The studies will allow to establish the relationship between microstructure, morphology, physico-chemical and functional properties of the co-polymers.