Mixed Matrix Membranes and their potential in climatic changes mitigation by CO_2 reduction

Magdalena Malankowska

Carbon dioxide is a final combustion product of carbon containing fuels. It is generated in big quantities and emitted in the gaseous form in case of industrial and energy production sites, transportation, building heating etc. Such emission contributes to the anthropogenic transmission which causes an increase in the CO_2 concentration in the atmosphere and contributes to climatic changes. To reduce these climatic changes, the emission of CO_2 needs to be reduced by a substantial amount.

The conventional substances that present high CO_2 sorption capacity (i.e. amines), besides their effective CO_2 capture, are characterized by the emission of toxic compounds and high vapour pressure. Accordingly, alternative types of technologies for a more efficient CO_2 separation need to be implemented.

Membrane based operations have the potential to replace conventional energy-intensive technologies and provide reliable solutions for sustainable growth. Gas mixture can be effectively separated by synthetic membranes made of polymers or ceramic materials. Even though such membranes are economically and technologically attractive, they are bounded by their performance, known as the Robeson limit, where permeability is sacrificed for selectivity and vice versa. One approach to overcome this limitation is to fabricate the so-called Mixed Matrix Membranes (MMMs). The first MMMs were prepared using conventional fillers such as zeolites or carbon molecular sieves. However, over the last few years, new materials have been incorporated such as carbon nanotubes, metal organic frameworks (MOFs) or graphene. MOFs have important advantages over other fillers, i.e. i) prevention of voids formation (typical for zeolites) which lowers the selectivity of the membrane and therefore causes it to underperform, ii) improvement of the filler-polymer interaction, avoiding the presence of non-selective micro-gaps.

In this work, we are showing two different MMMs with distinctive MOF used as a filler for two applications: post and pre-combustion gas separation.