# MSC assignment: Development of ceramic-supported 2D inorganic nanosheet membranes for organic solvent nanofiltration

Many industrial process streams contain a mixture of water, solvents and other organic components. To reuse these streams, purification is required. In this project, the aim is to make a new class of solvent tolerant nanofiltration membranes prepared of two-dimensional nanomaterials for use in the purification of waste streams, containing a water/solvent/solute mixture. This is the field of Organic Solvent Nanofiltration (OSN). The reuse of these large waste streams will result in significant reduction in energy and contributes to the circular economy.

The Interest of two-dimensional (2D) nanomaterials (*e.g., graphene, exfoliated dichalcogenides, metal-organic framework (MOF) nanosheets*) in membrane science and especially in OSN application is growing [1-4]. The control of the thickness and the size but also the presence of unique nanopores and nanochannels in the 2D nanomaterials are supposed to play a significant role in the membrane permeation flux and selectivity. These 2D-nanosheets-based membranes are typically prepared by intercalation of guest components and exfoliation using a solvent [1].

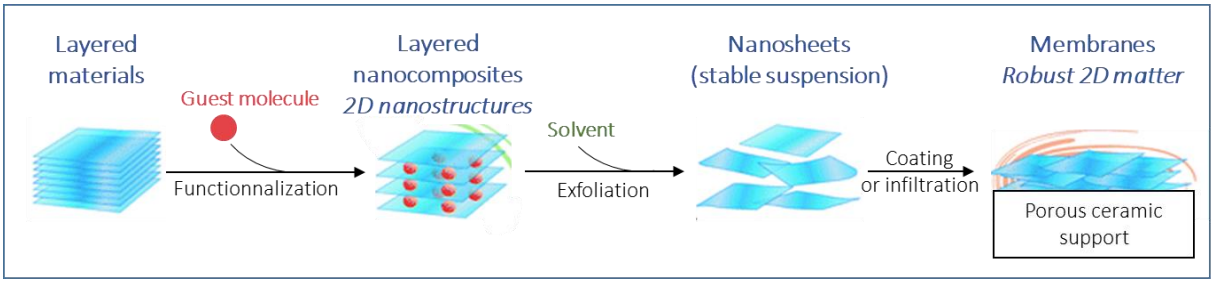


**Figure 1.** Overview of typical nanosheet-based membranes and their preparation routes.

In this Master assignment, the candidate will benefit of the expertise and equipment of the Inorganic Membrane group to:

1. **Prepare ceramic-supported 2D inorganic nanosheet membranes on commercial ceramic supports**. This method implies the functionalization of a commercial powder followed by the exfoliation of the powder to prepare stable nanosheets suspension. The last step consists of the coating or infiltration of the suspension on a commercial porous ceramic support.
2. **Characterize the as-prepared membranes** by various techniques like XRD, FTIR, AFM, permporometry, electron micrsocopy etc…
3. **Find key parameters** (thickness, adhesion to the support, etc...) **that control membrane properties.**
4. **Evaluate the performance of the membranes under OSN condition**.

***Skills which will be developed during the Master assignment:***

- Synthesis of 2D nanomaterials and porous ceramic membranes
- Characterization of the as-prepared membranes (XRD, SEM, EDX, FE-SEM, *FTIR, AFM, permporometry, MWCO, $N_2$ permeation, etc...)*
- Evaluation of the membrane performances under OSN conditions (a mixture of water, solvent, and solutes)

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