Membranes with ordered, self-aligned pores for valorization of aqueous streams and ion separations

There are four billion people facing at least one month/year of water scarcity. Simultaneously, in many industrial processes the removal of salts and minerals and the selective recovery of ionic species from aqueous streams is essential to valorize waste streams and to safeguard resource availability. This requires energy efficient, effective and ion selective desalination technology.

The aim of this project is to develop membranes with uniform pores aligned over the thickness of the membrane using liquid crystal polymers (LC). Until now much research has been performed to mimic biological cell membranes to create membranes with well-defined uniform pores applicable in large-scale technological applications. However, their practical application for large industrial processes is far off as up to now such materials can only be created at very small cm$^2$-scale and in thin layers, which results in weak mechanical stability of the membrane. The mechanical stability can be improved by using a porous support. Chemical modification of the LC polymer film introduces specific functionalities at the surface and in the pores to control e.g. fouling and to tune pore sizes to the level of true molecular separation.

Liquid crystals are characterized and embedded within a support. The alignment of the LC’s are controlled by temperature and by interaction with the support material. Next the LC are photo-polymerized, so they maintain their structure at room temperature. Subsequently, the polymer network is treated by an alkaline solution to create the pores. The prepared membranes will be characterized and their performance will be evaluated and validated using real industrial feeds from the dairy industry.

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