Filtration and selective retention through hydrogels

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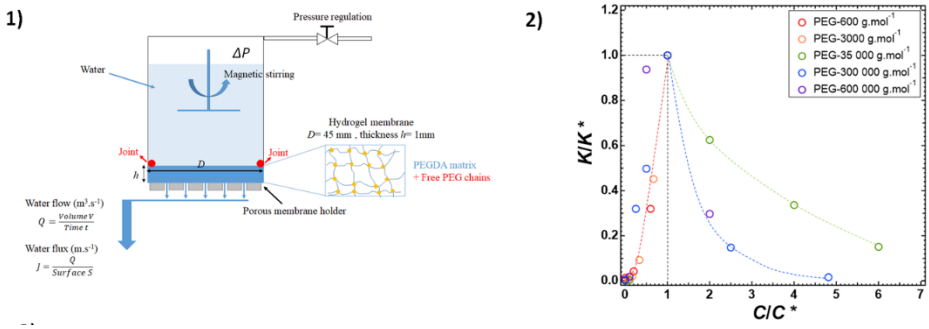
Pressure-driven membrane technologies, such as microfiltration, ultrafiltration, nanofiltration and reverse osmosis, have proven their effectiveness in a broad range of water treatment applications [1]. Hydrogels, which are networks of polymer chains in water, have been the subject of recent work in the context of filtration [3]. For example, thin coatings of hydrogels (<100 nm thick) deposited on classical filtration membranes allow to increase the hydrophilicity of the membranes and to decrease their fouling by hydrophobic proteins [4]. An important remaining challenge is to control the selectivity and permeability of the hydrogels.

We have developed a series of hydrogels of controlled permeability obtained by a simple and robust method. We photopolymerize poly(ethylene glycol) diacrylate, (PEGDA) under UV light in the presence of non-crosslinkable PEG free chains.

We find that the PEG chains are trapped in the matrix and nevertheless enable to increase the permeability by orders of magnitude [5,6]. To account for this behavior we suggest that the PEG chains induce nanodefects in the cross-linking density that controls the permeability of water through the hydrogels. Furthermore taking advantage of the fact that the free polymer chains are trapped in the PEGDA hydrogels we vary the type of free polymer chains to functionalize our hydrogels and selectively retain solutes through hydrogel bonds or electrostatic interactions.

This study opens new perspectives for the design of flexible hydrogel membranes with controlled permeability and their application in water treatment and bioseparation.



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