# Electric field-assisted membranes for molecular separation

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Using anodic aluminum oxide (AAO) as a material platform, Thermosolv is developing new nanostructured ceramic membranes for molecular separation; the field of organic solvent nanofiltration is one example of the potential applications. AAO – a self-organized material formed by anodizing aluminum metal – has highly uniform and ordered nanoscale pores, Fig. 1. Through precise control of anodization parameters, pore diameter and period are tunable from several nm to several hundred nm, and can be varied along the pore length. The asymmetric membrane structure includes (i) relatively thick 50-100 µm support layer with large-diameter (>100 nm) pores and (ii) thin sub-µm active layer with monodisperse nanometer-scale pores, Fig. 2.

Depositing electrically conductive metallic layer on the membrane surface allows applying an electric field to the pore entrances. Small diameter of the pore openings will render the field inside the pores highly non-uniform. While not affecting noticeably the flow of solvent molecules, the field introduces dielectrophoretic force affecting the motion of the solutes, Fig. 2. For a given system of solutes/solvent, and for specific membrane pore size, the applied potential will control the molecular weight cut-off of a membrane across a wide and tunable range.

Case studies for fractioning organic dyes with the molecular weights in the range 100-3000 Da will be presented, Fig. 3.

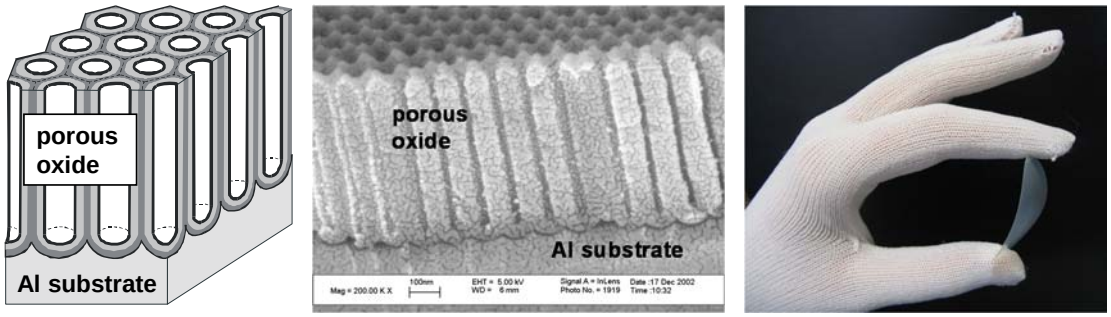



**Figure 1. Artist's concept and SEM image of AAO, and free-standing AAO film.**

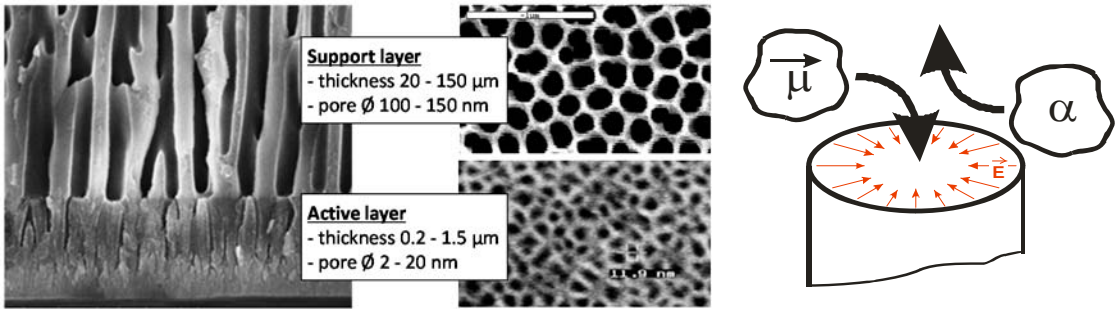



**Figure 2. Asymmetric membrane structure (left) and dielectrophoretic separation (right).**

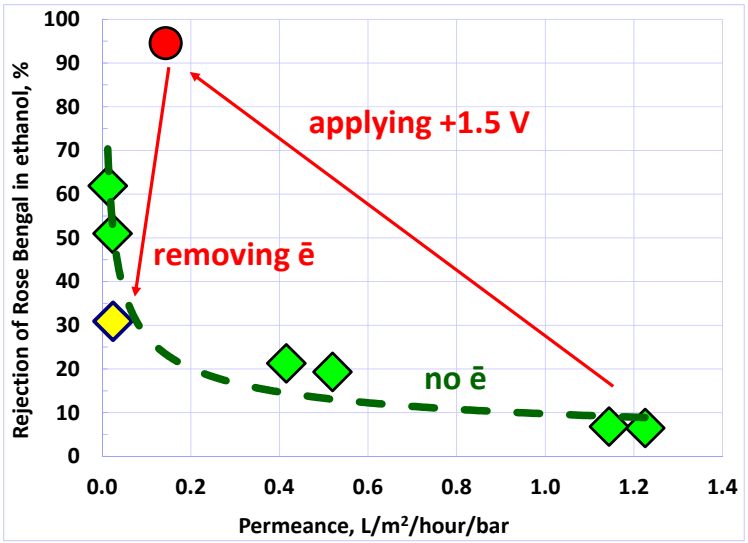



**Figure 3. Applied potential changes the membrane selectivity and permeance.**