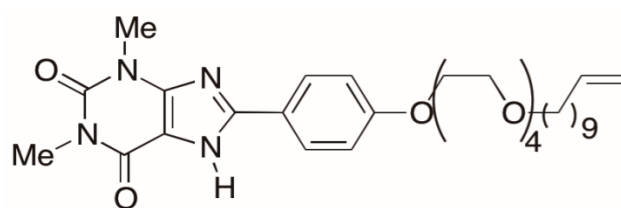
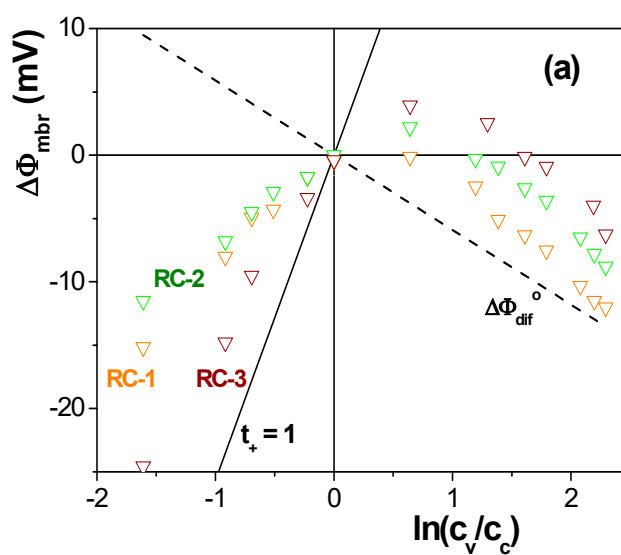
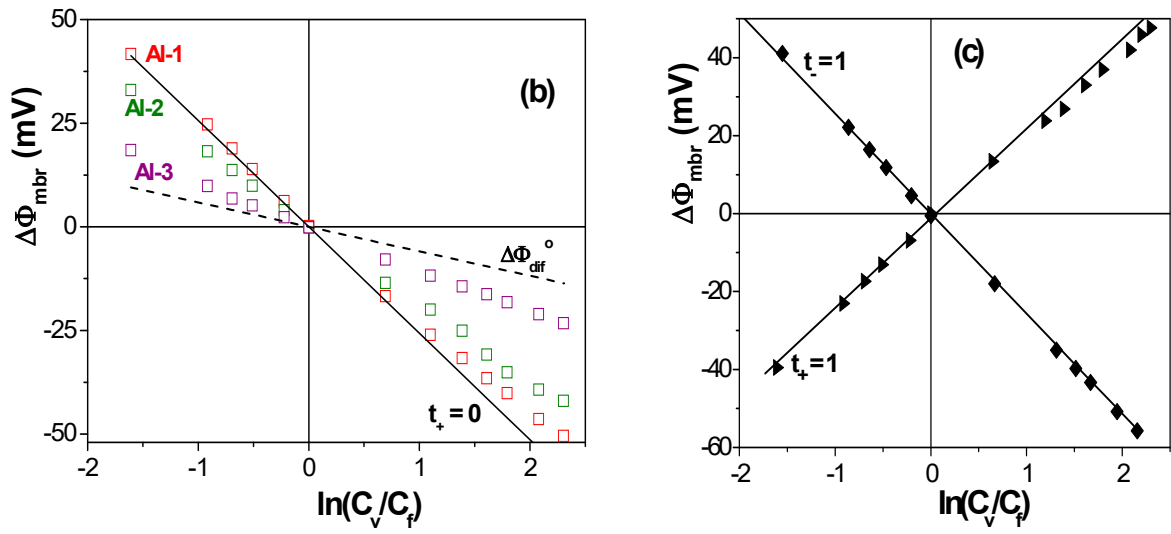


**Figure S1.** SEM micrographs: (a) supported structure and surface (insert) of CRF25 membrane, and (b) cross section; black bars correspond to 1  $\mu\text{m}$ . (c) top surface of the And-NPAM, black bar is 100 nm; (d) cross section of the And-NPAM, white bar corresponds to 1  $\mu\text{m}$ ; (e) down surface of the And-NPAM, black bar corresponds to 500 nm. (f) Sfw-NPAM surface, line corresponds to 1  $\mu\text{m}$  and (g) pore size distribution diagram of the Sfw-NPAM.



**Figure S2:** Theophylline-oligo(ethylene glycol)-alkene derivative or Theo 1. Theophylline-oligo(ethylene glycol)-alkene derivative 1 (or Theo 1) was prepared by following the procedure previously developed in [1-SI]. The And-NPAM sample was immersed in a dichloromethane solution of Theo 1 and slowly stirred for half an hour at room temperature. The membrane was then removed, washed with dichloromethane and then dried at room temperature for 24 h in a disecator to obtain the modified And/Theo 1-NPAM sample.





**Figure S3.** Variation of membrane potential values with solution concentration ratio. (a) regenerated cellulose membranes: RC-1 ( $\nabla$ ), RC-2 ( $\nabla$ ) and RC-3 ( $\nabla$ ). (b) ideally nanoporous alumina membranes: Al-1 ( $\square$ ), Al-2 ( $\square$ ) and Al-3 ( $\square$ ). (c) ( $\blacklozenge$ ) Anion exchange membrane (IONICS), ( $\blacktriangleright$ ) cation exchange membrane (Nafion).  $\Delta\Phi_{dif}^o$ : NaCl solution diffusion potential. Membrane characteristics: RC-1: 2 kDa pore size; RC-2: 12 kDa pore size; RC-3: swelling membrane (55 % swelling degree). Al-1: 22 nm pore size, 10 % porosity; Al-2: 32 nm pore size, 8 % porosity; Al-3: 170 nm pore size, 10 % porosity.