CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

IEM MONTPELLIER

Hybrid biomimetic membranes: past present and beyond...

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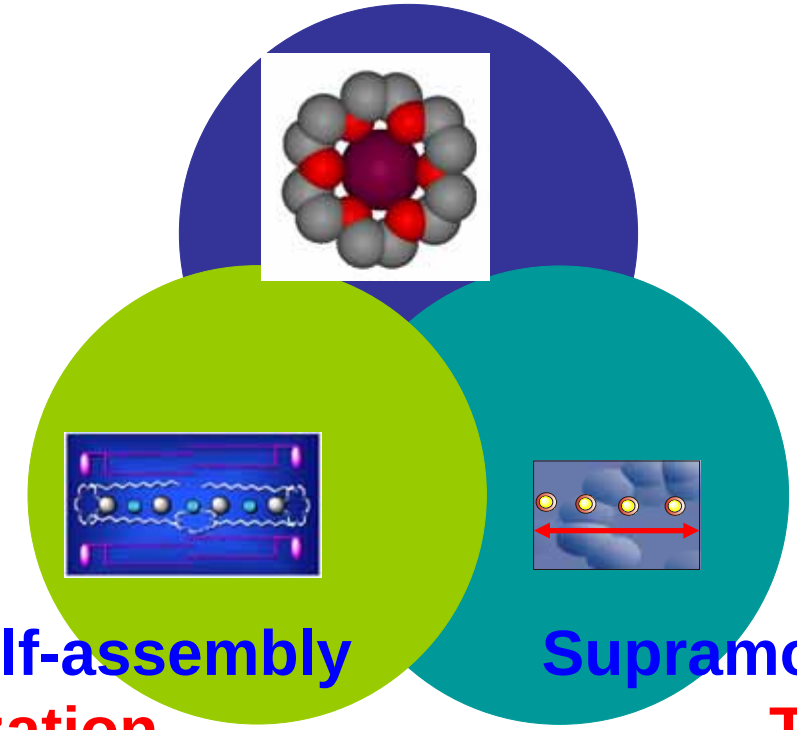
Informed molecular components

Molecular recognition

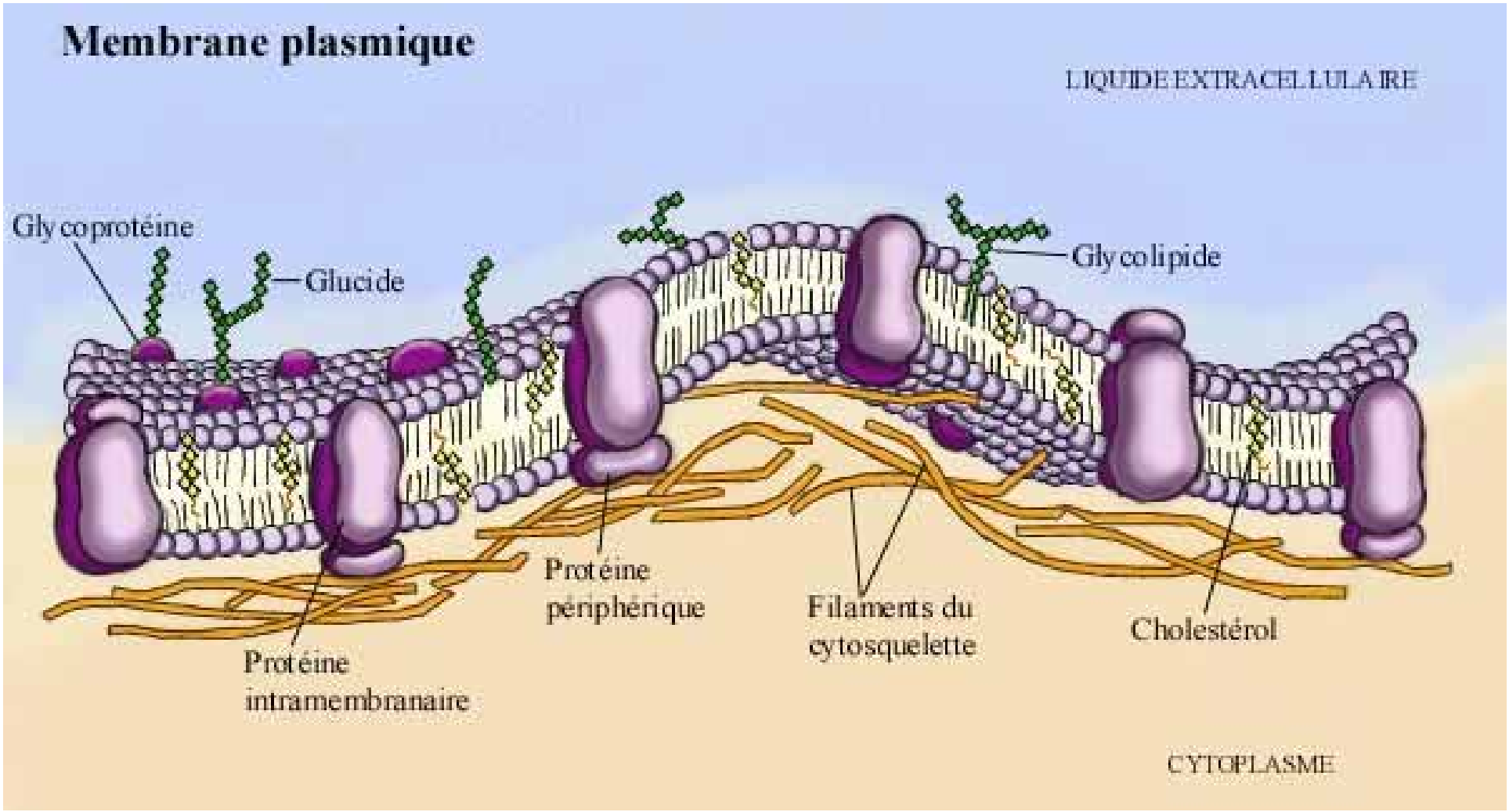


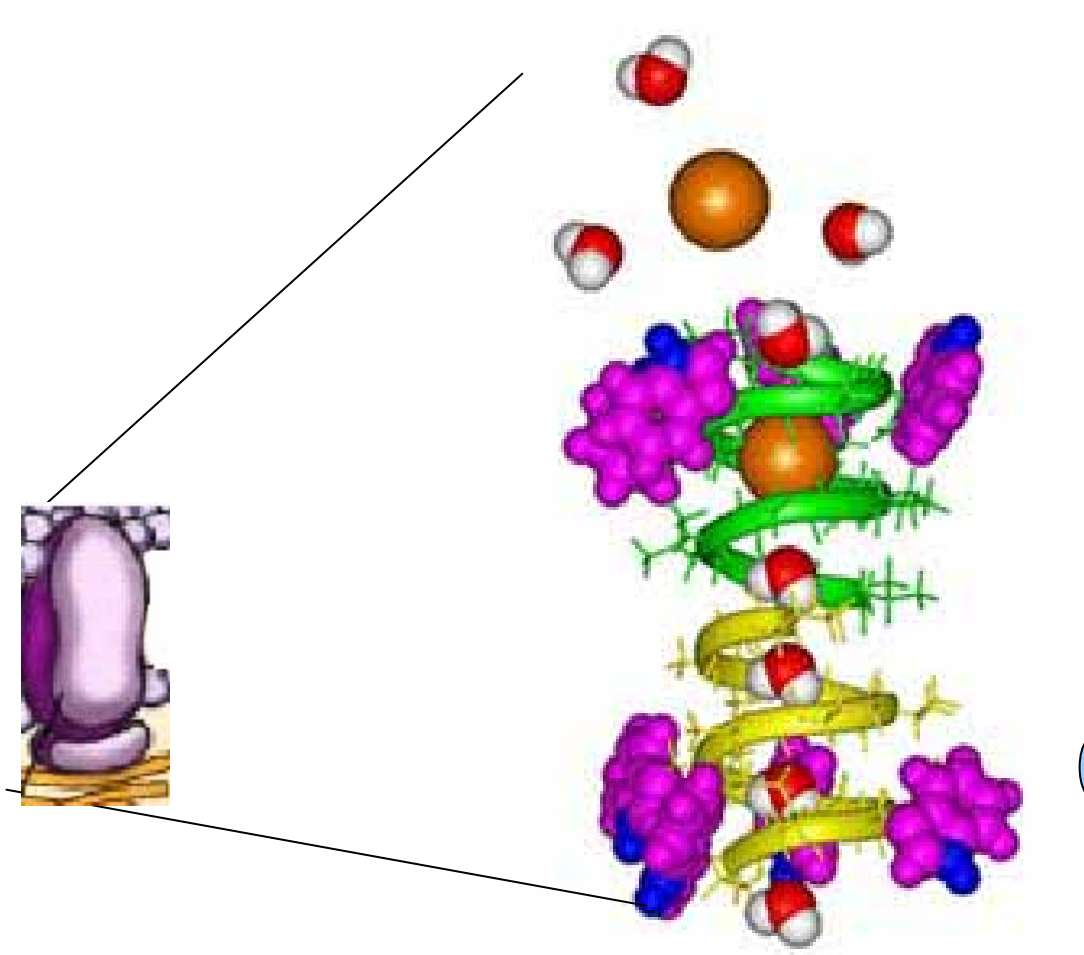
Supramolecular self-assembly

Self-organization

Supramolecular function

Transport


Membrane plasmique
LIQUIDE EXTRACELLULAIRE
Glycoprotéine
Glucide
Glycolipide
Protéine périphérique
Filaments du cytosquelette
Cholestérol
Protéine intramembranaire
CYTOPLASME



Evolutive

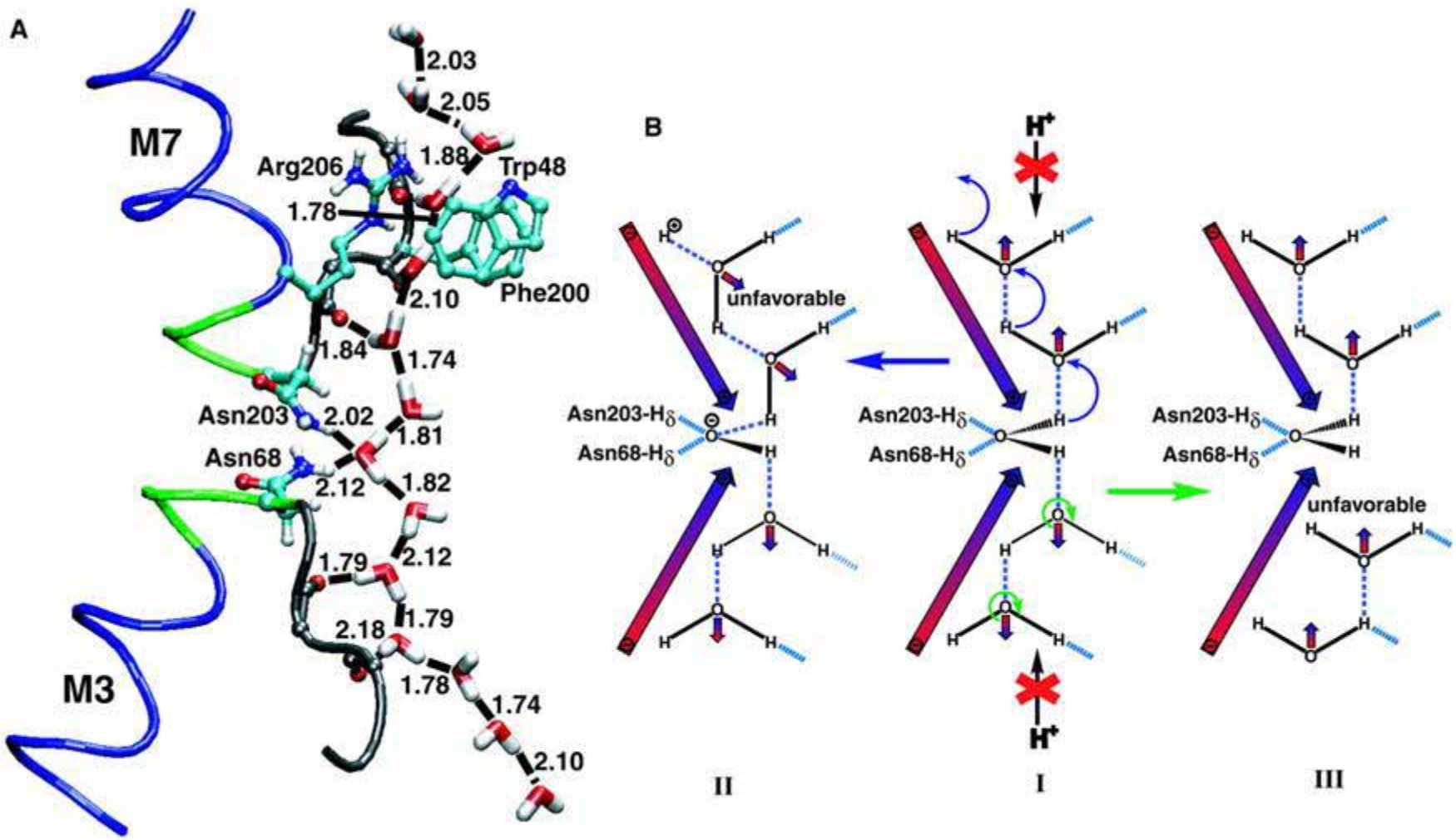
Adaptative

Dynamic

Collective

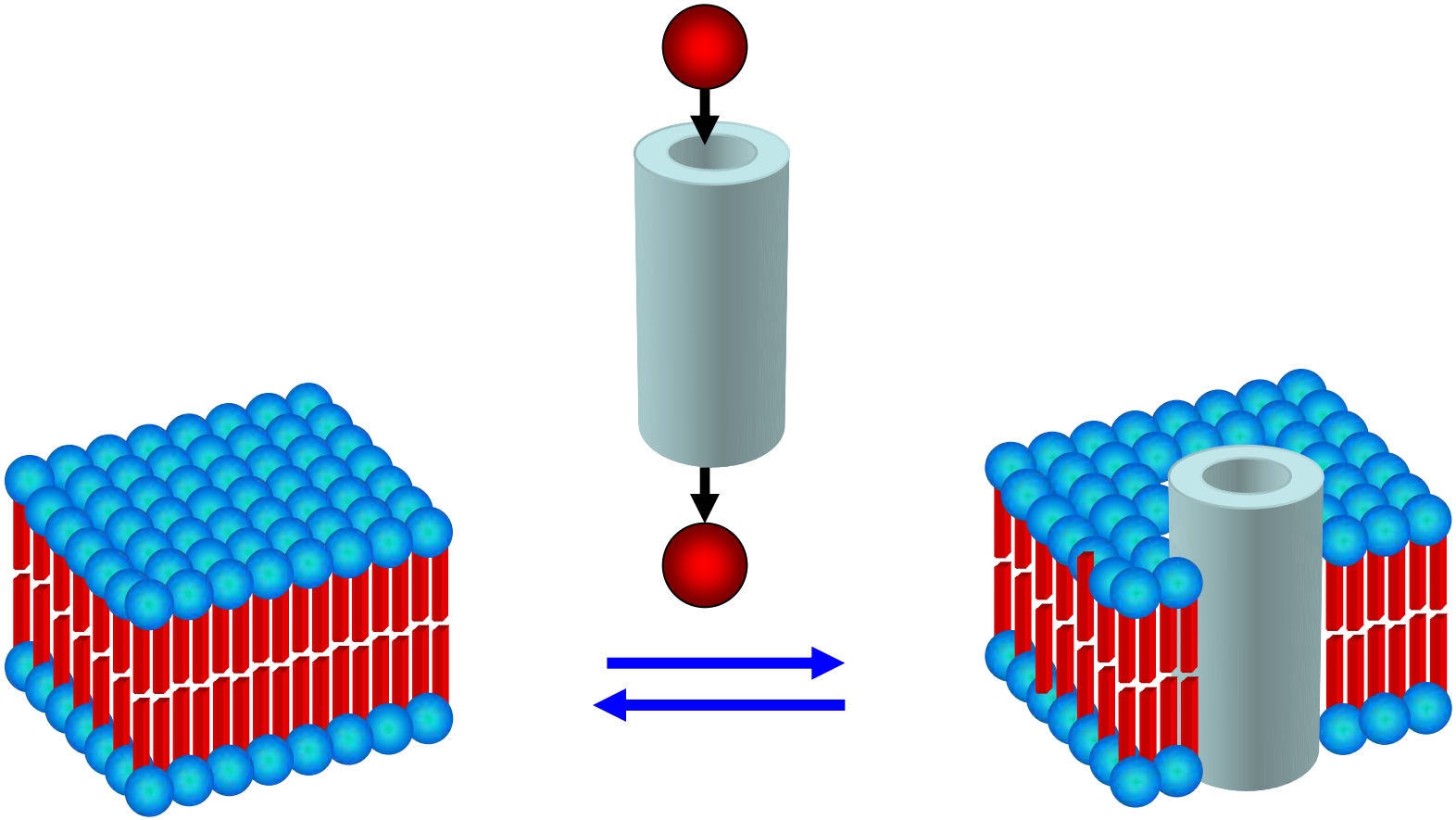
Water versus proton permeability of AQP1

Proton release can only be half-propagated to the central water and results in an unfavourable relative water orientation on the other half-terminus



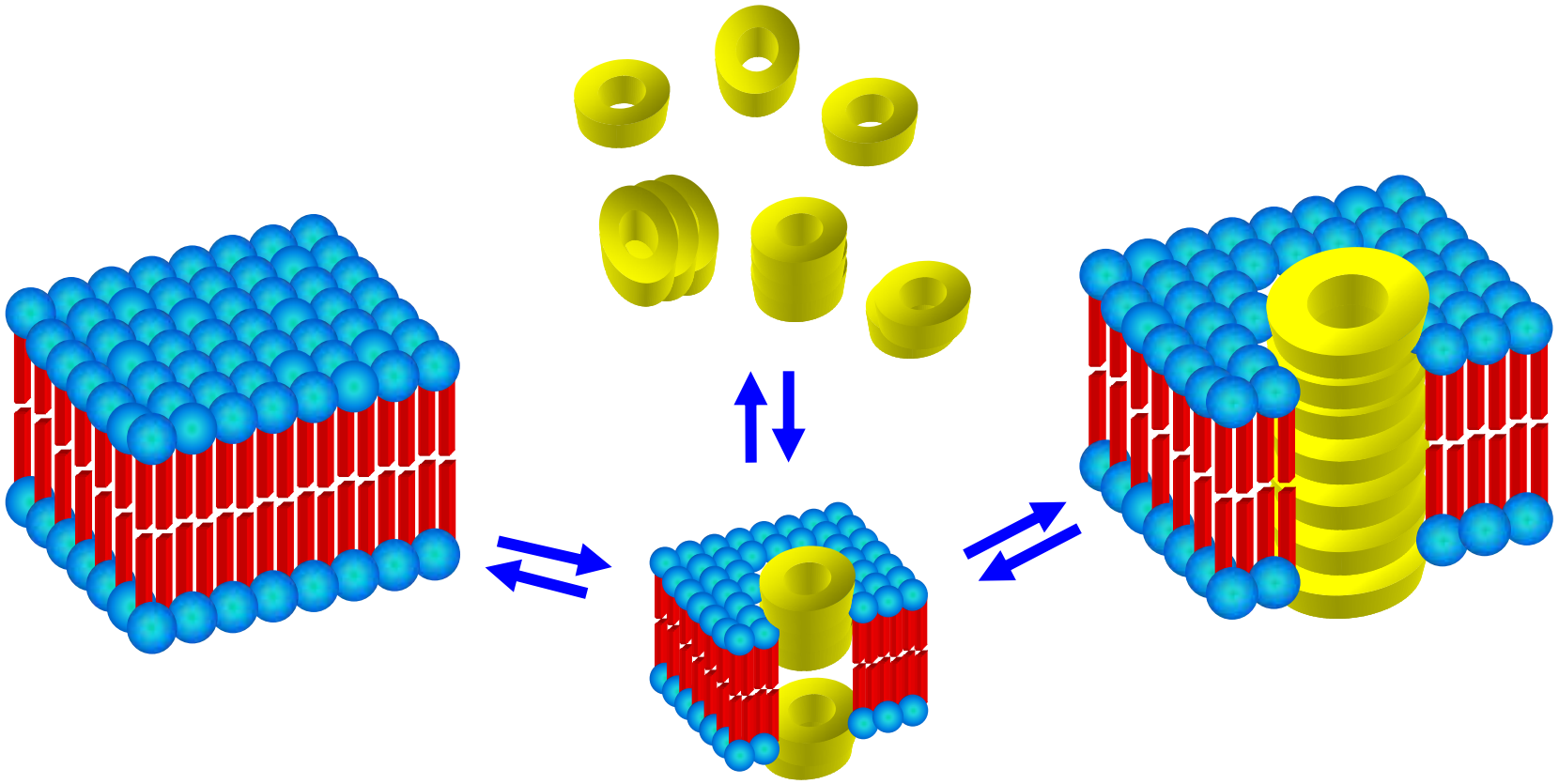
E. Tajkhorshid et al., Science 296, 525 -530 (2002)

Supramolecular organization of biological entities - toward a supramolecular function



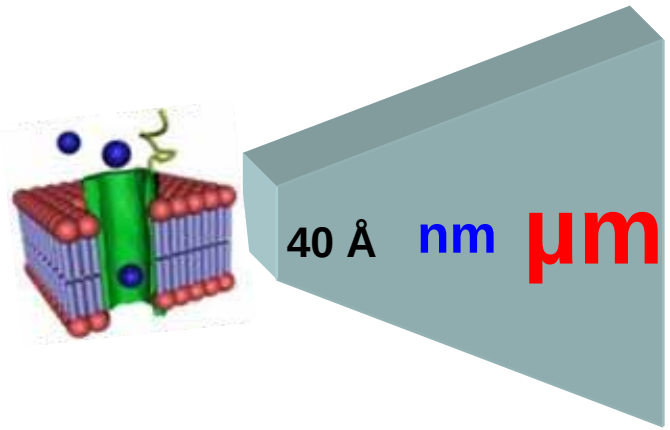
Going to functional transport patways....by self-assembly

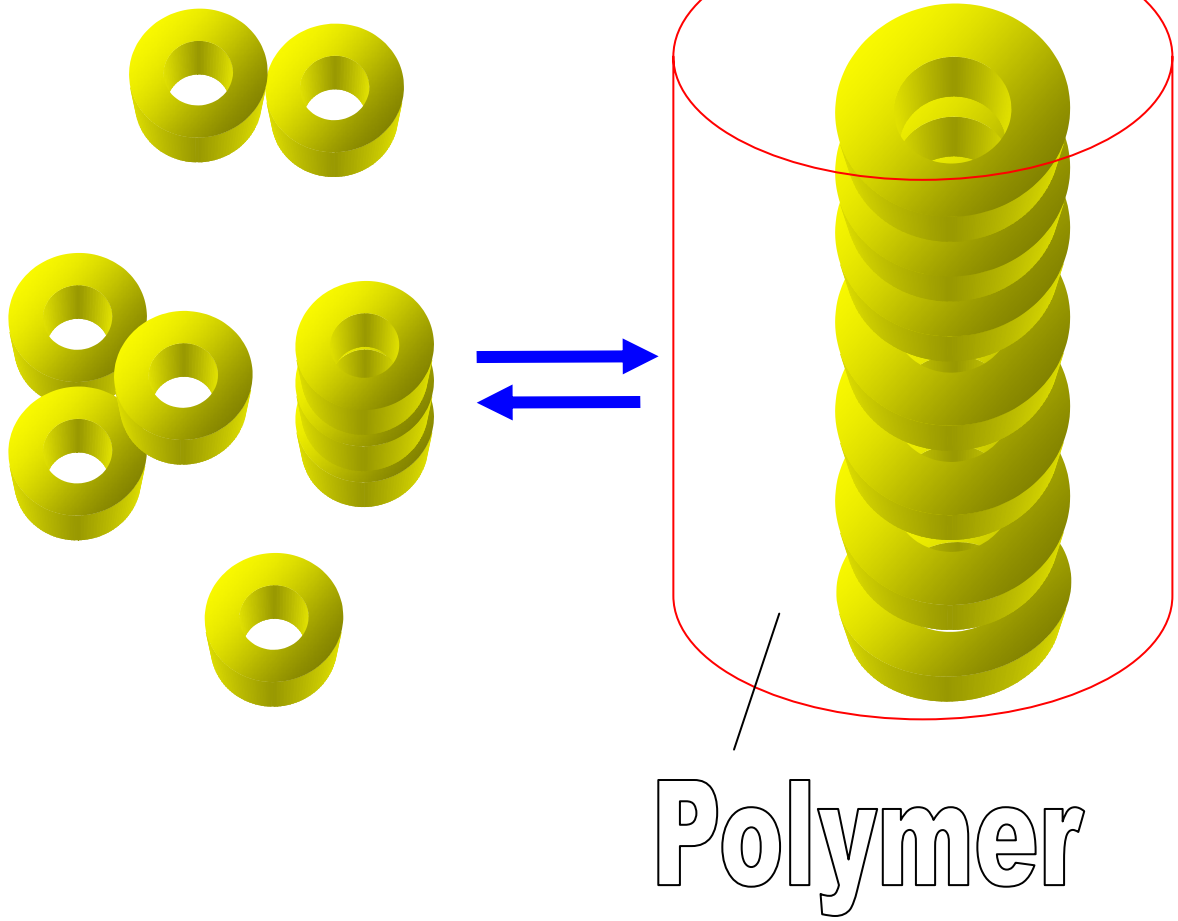
Despite the thermodynamic stability of the assemblies resulted from simple molecular components they are in dynamic equilibrium between monomer and supramolecular oligomers and only few examples clearly showed single-channel activity in lipid bilayers (40 Å)



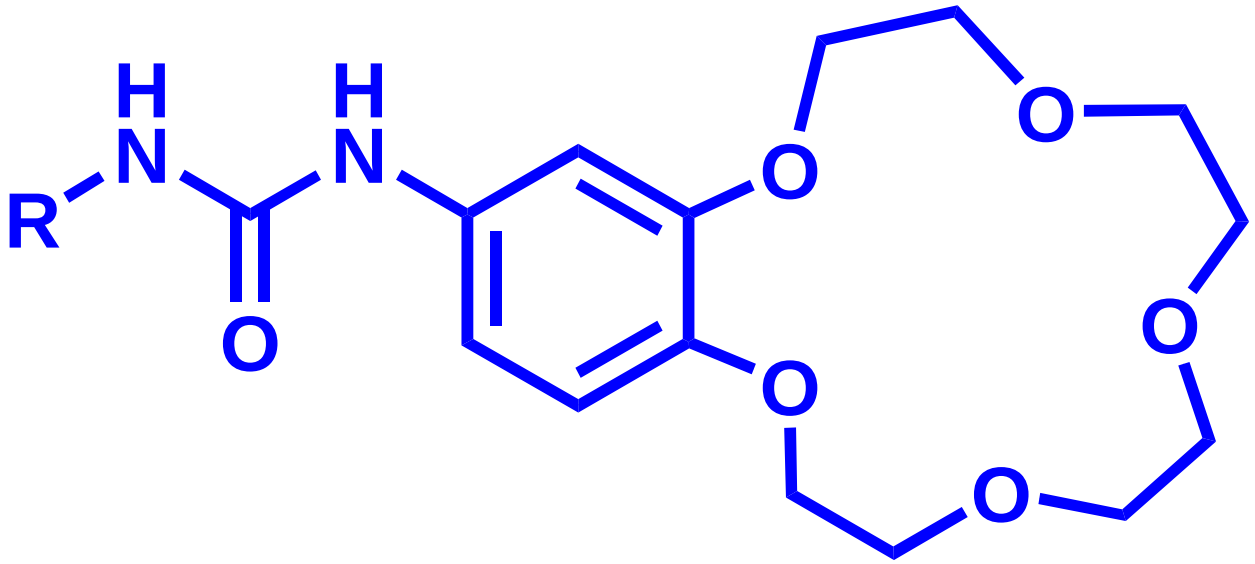
Going to functional supramolecular devices....by self-assembly

"Supracombimat"
exploring the chemical diversity by:
selection,
amplification,
fixation
in polymers



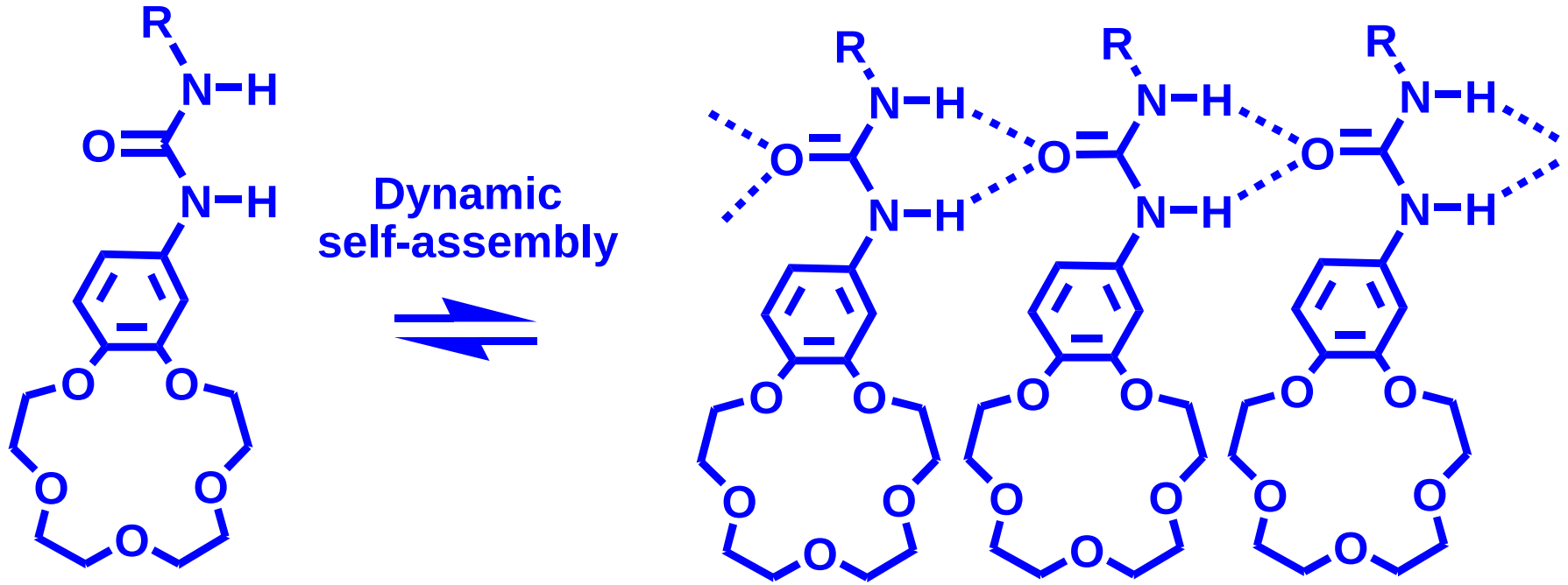


Self-organized membranes



1, R= -C_6H_5, 2, R= -C_5H_{11}, 3, R= -$C_{18}H_{37}$,
4, R= -C_3H_7, 5, R= -$C_3H_7SiO(Et)_3$,

Self-organized membranes



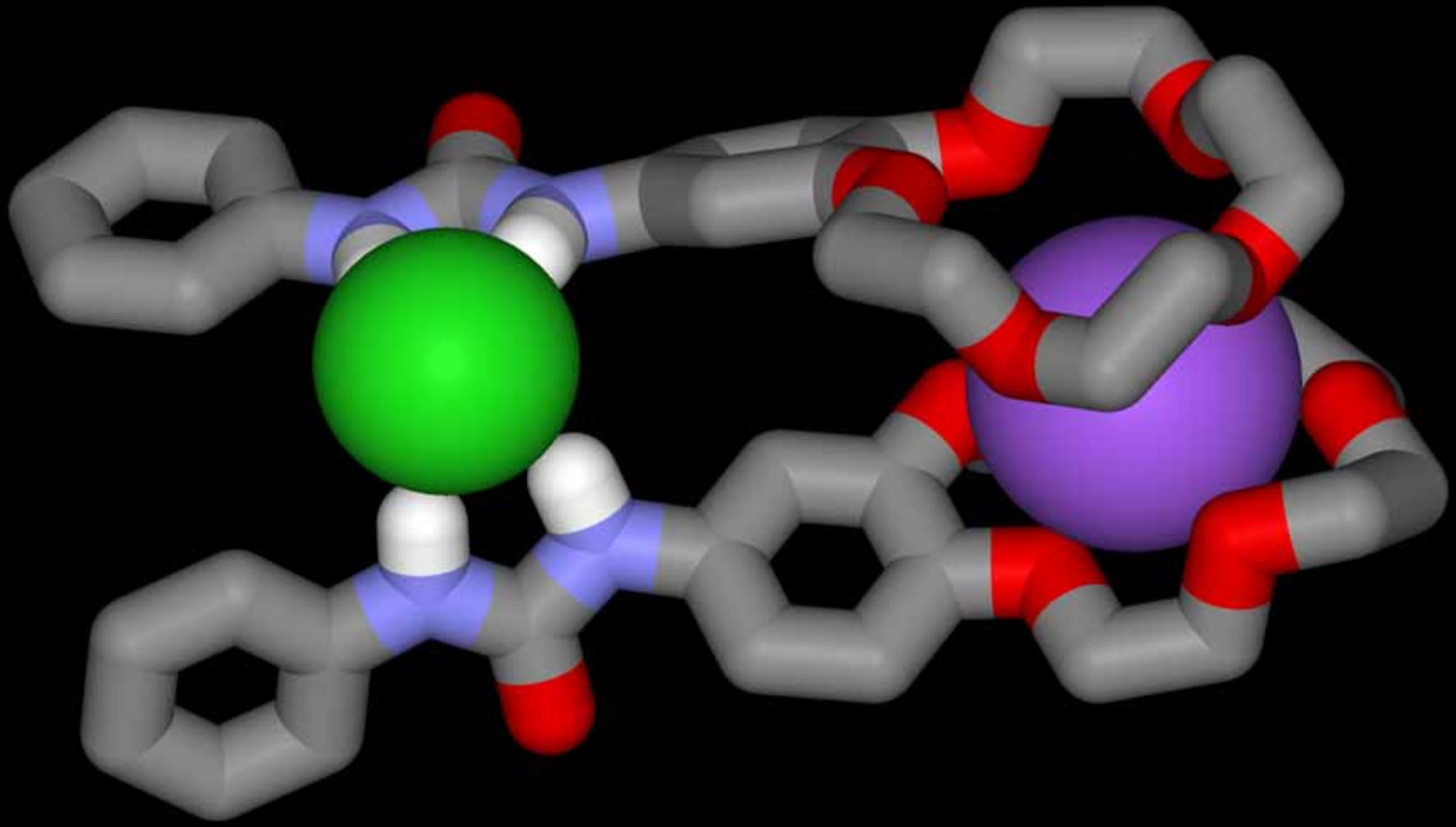
Molecular recognition of the carrier monomers

Channel-forming polyassociated superstructures

JACS 2006, 128, 9541

***J. Incl. Phenom. Mol Rec*. 2004, *49*, 133.**

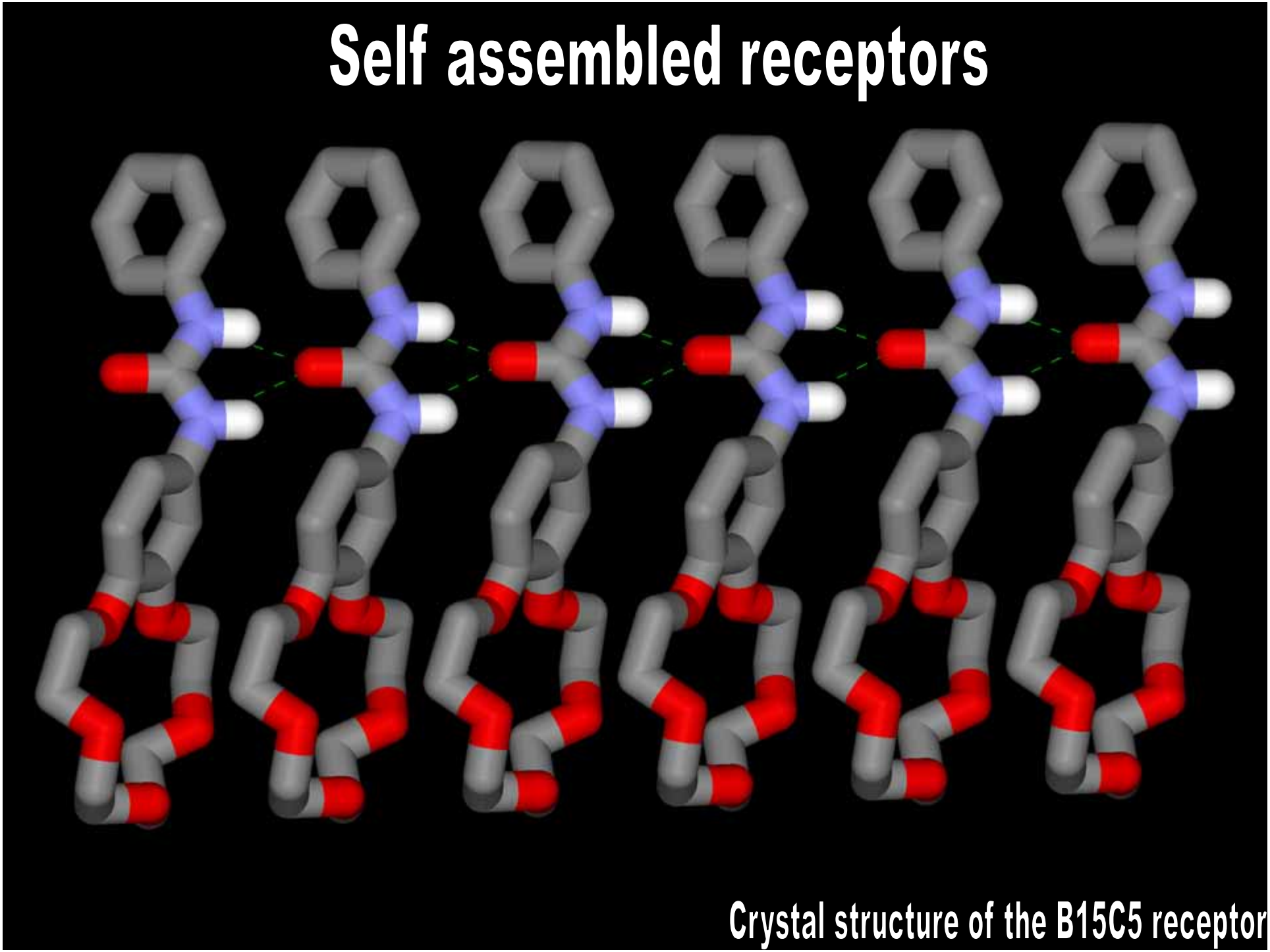
Heteroditopic receptors-dimers



Org. Lett. **5, 3073 (2003).**

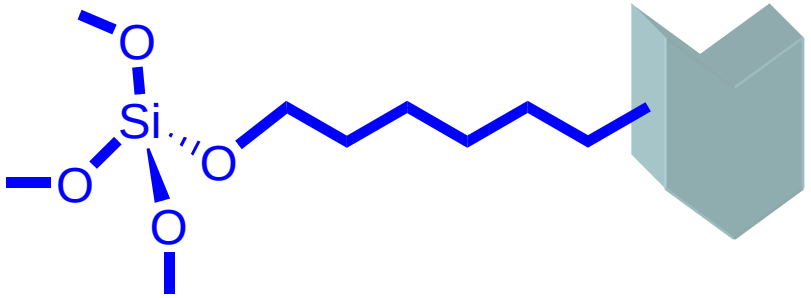
Crystal structure of the 15C5*NaCl complex

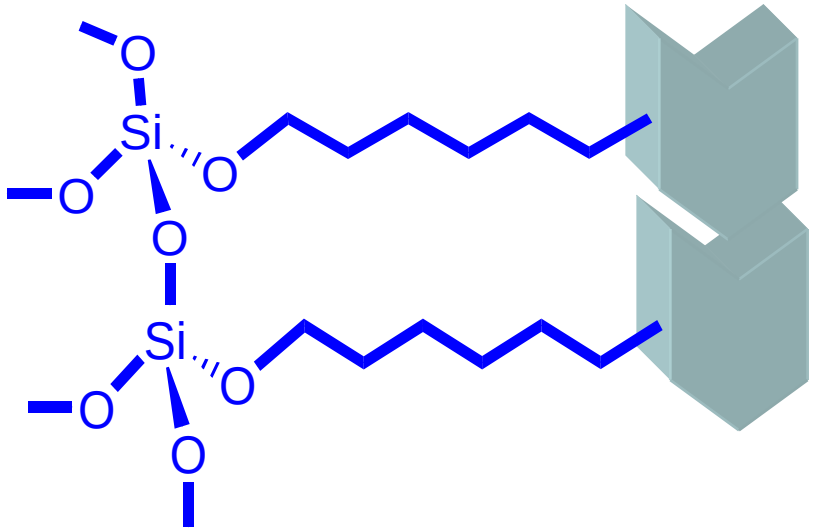
Self assembled receptors



Crystal structure of the B15C5 receptor

Hybrid supramolecular heteropolysiloxanes by sol-gel





Hydrolysis: slow, H^+

$$\text{-Si-OR} + H_2O \rightleftharpoons \text{-SiOH}$$

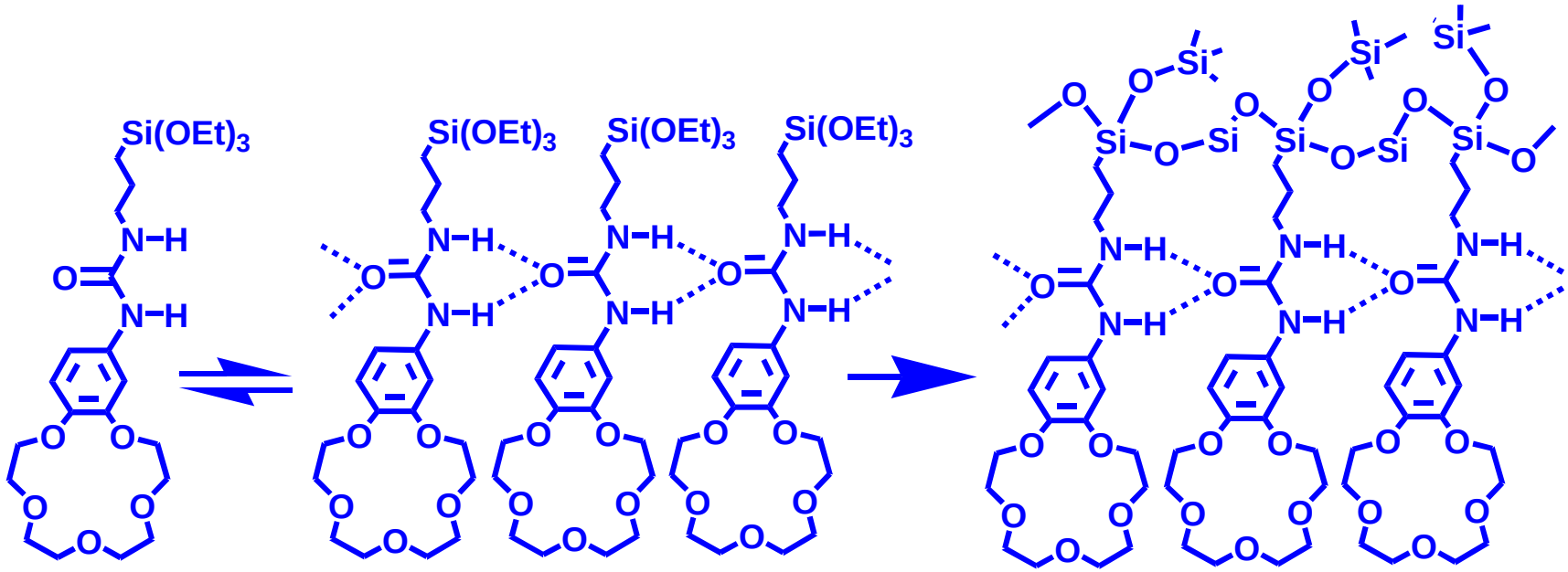
Condensation: fast, OH^-

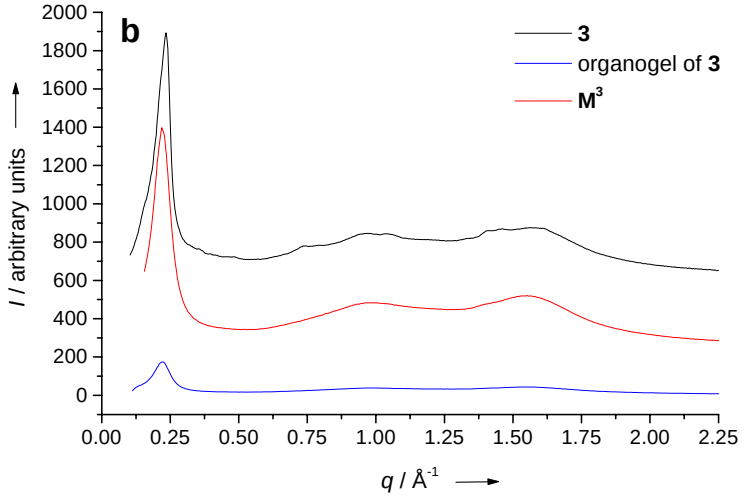
$$\text{-Si-OH} + \text{-Si-OH} \rightleftharpoons \text{-SiOSi}$$

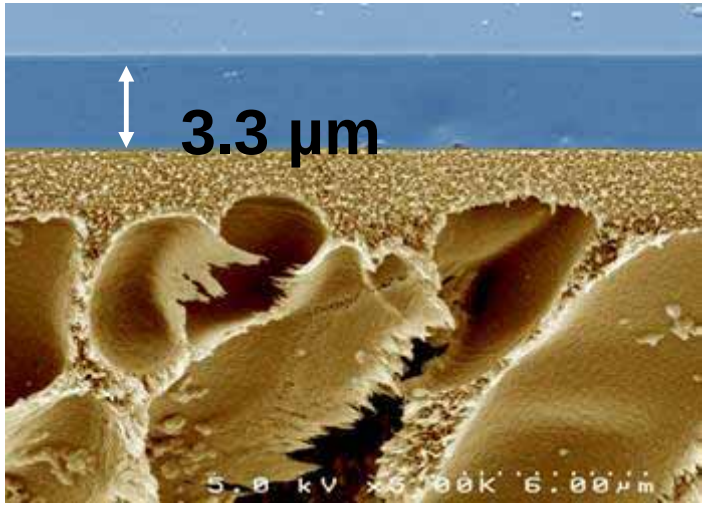
$$\text{-Si-OH} + \text{-Si-OR} \rightleftharpoons \text{-SiOSi}$$

$$\text{-Si-OR} + \text{-Si-OR} \rightleftharpoons \text{-SiOSi}$$

Self-organized thin-layer hybrid membranes



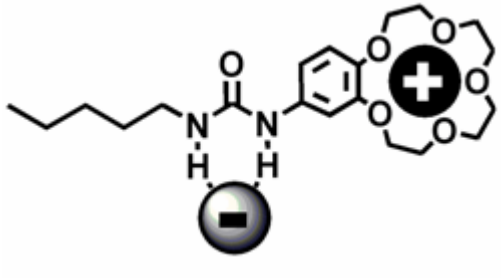




J. Am Chem.Soc., 2004, *126*, 3545-3550.

Self-organized membranes

ATP ion-pump fuelled by Na^+ concentration gradient



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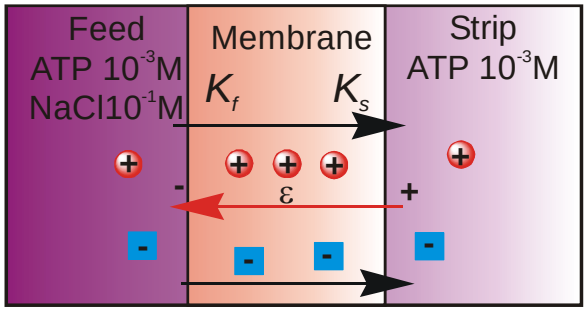
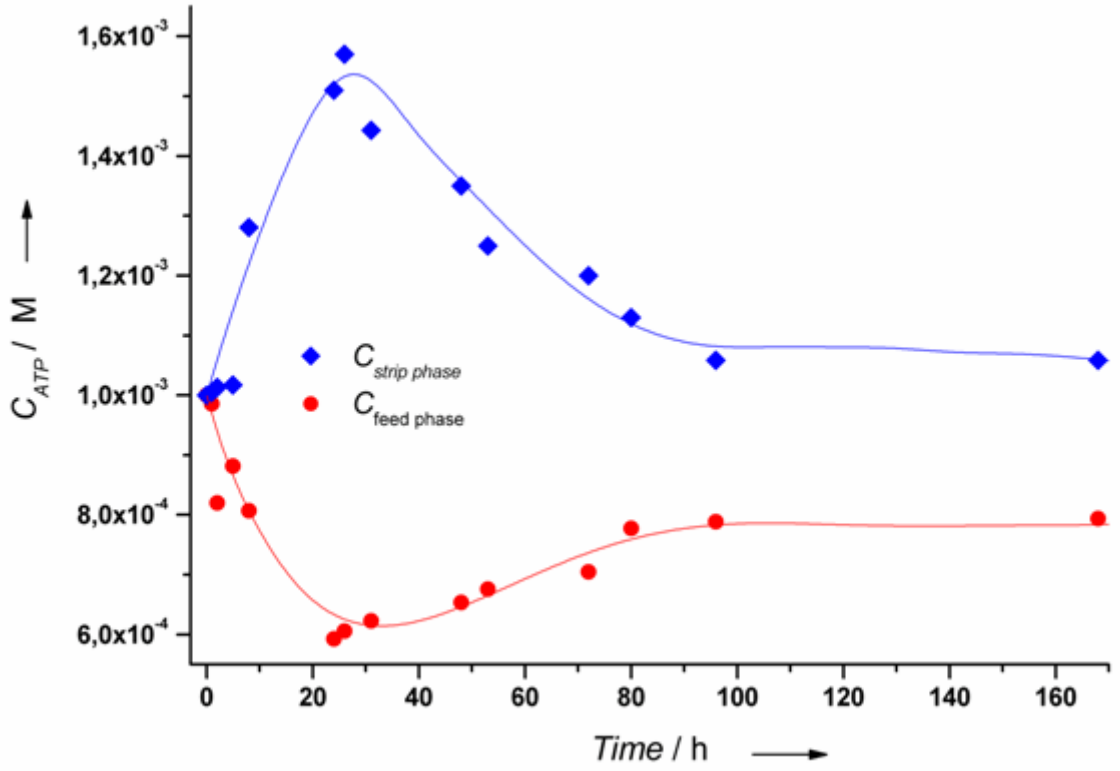
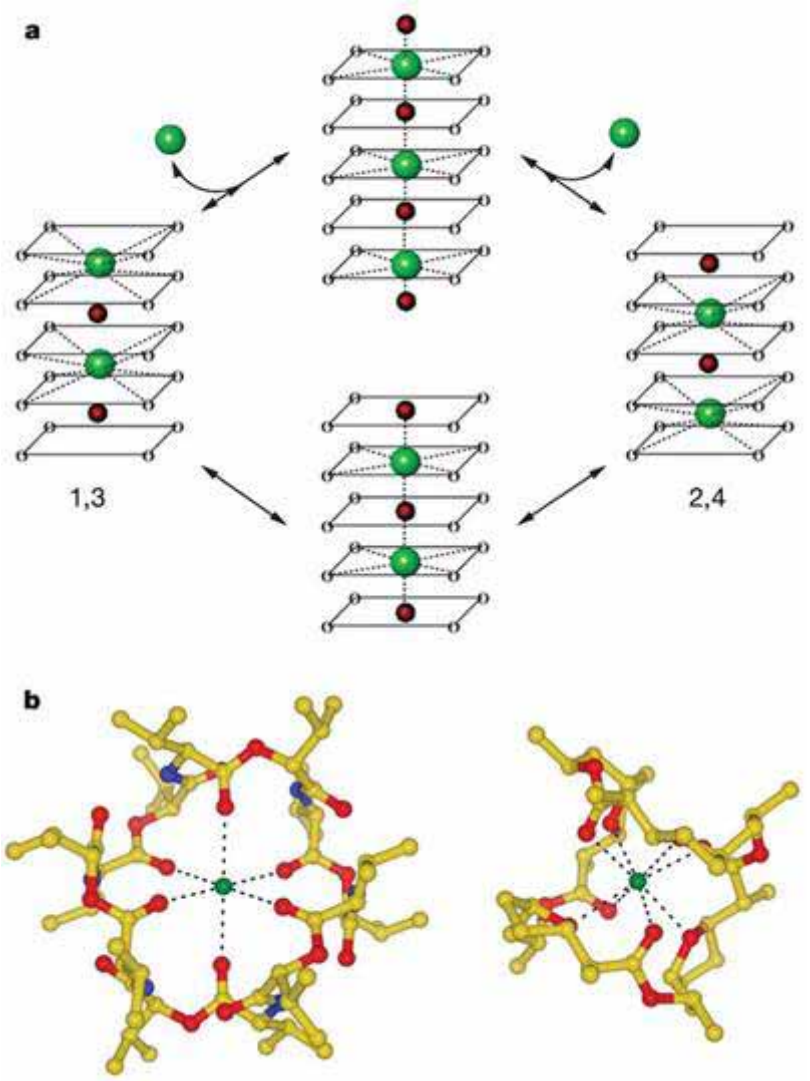
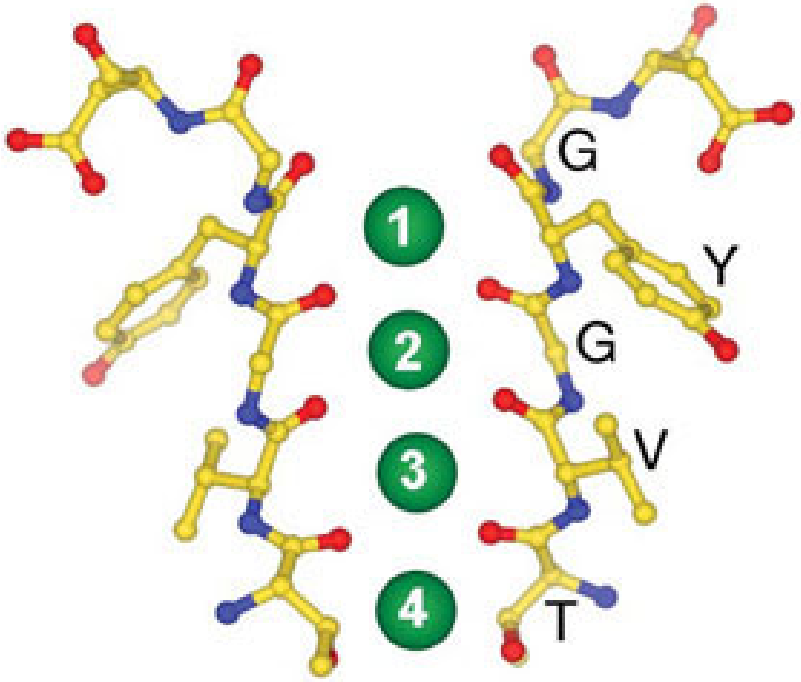




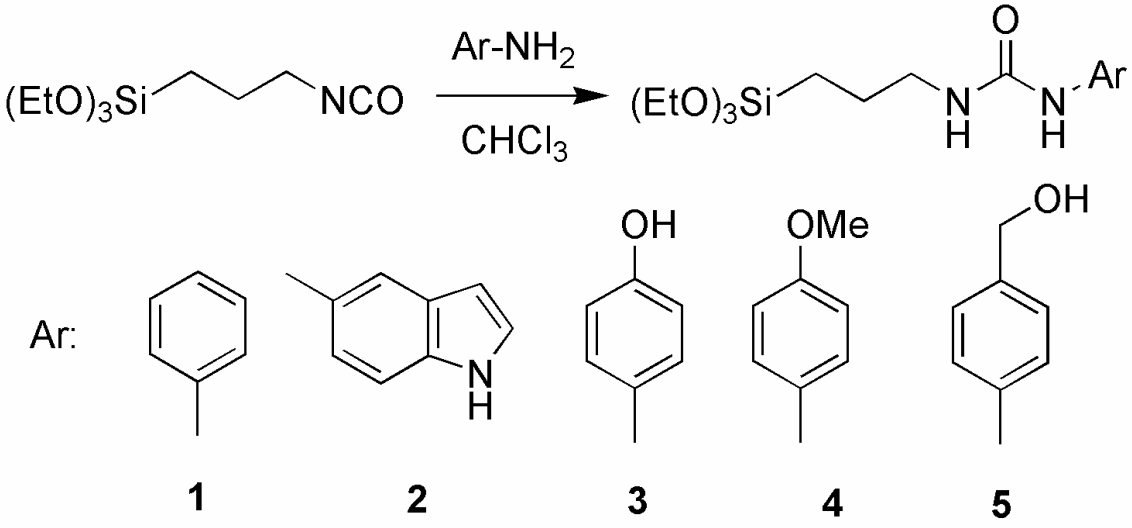
J. Am. Chem. Soc., **2004**, *126*, 3545

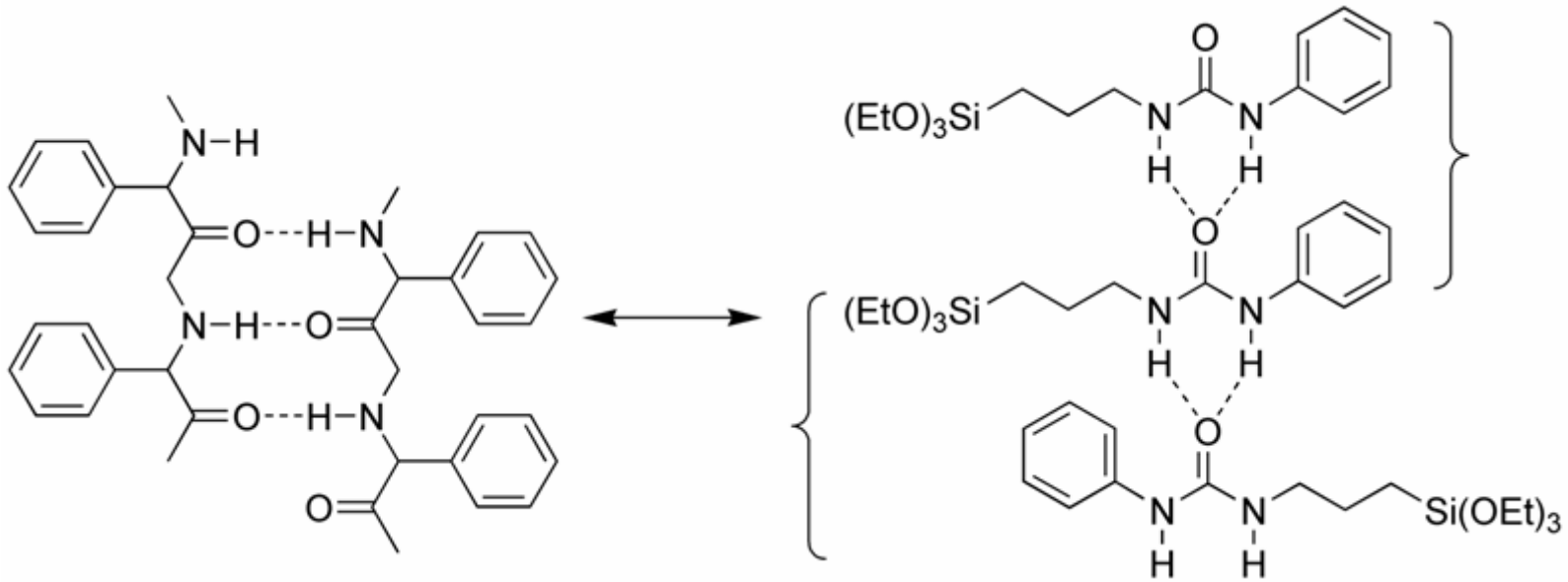
KSCa Transport Channel: functional devices





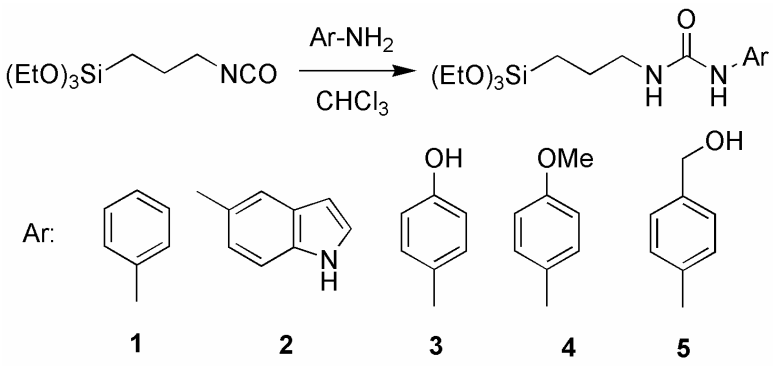
Self-organized "peptoid" hybrid membranes

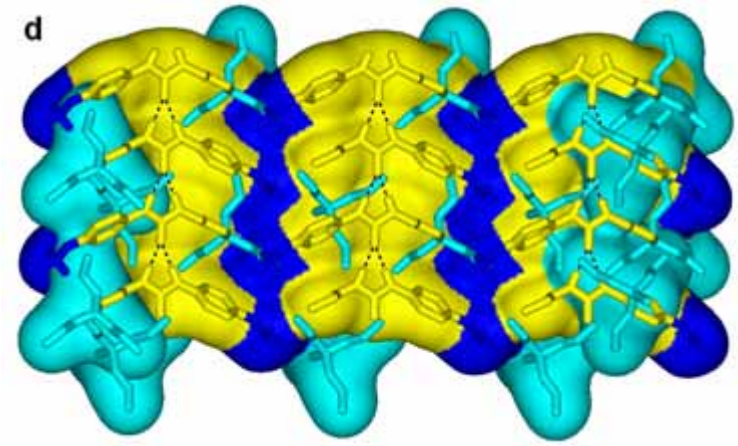


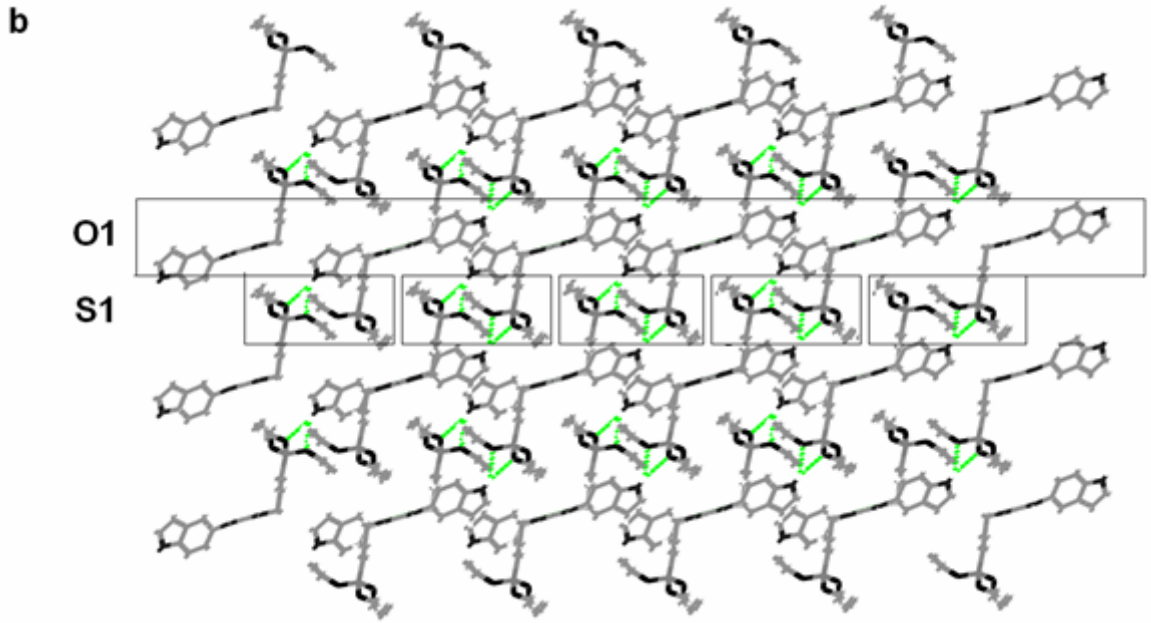


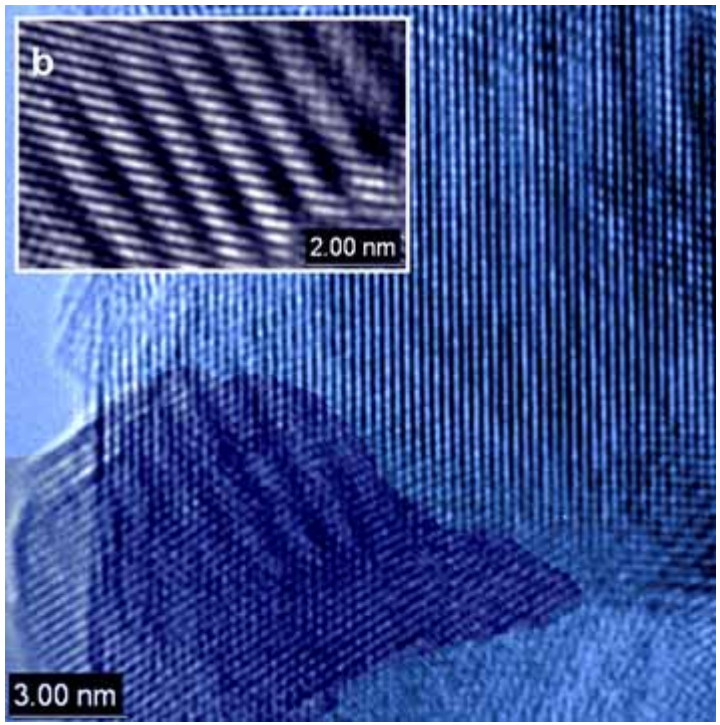
Chem. Eur.J. **2008**, *14,* 1776-1783.

Self-organized "peptoid" hybrid membranes



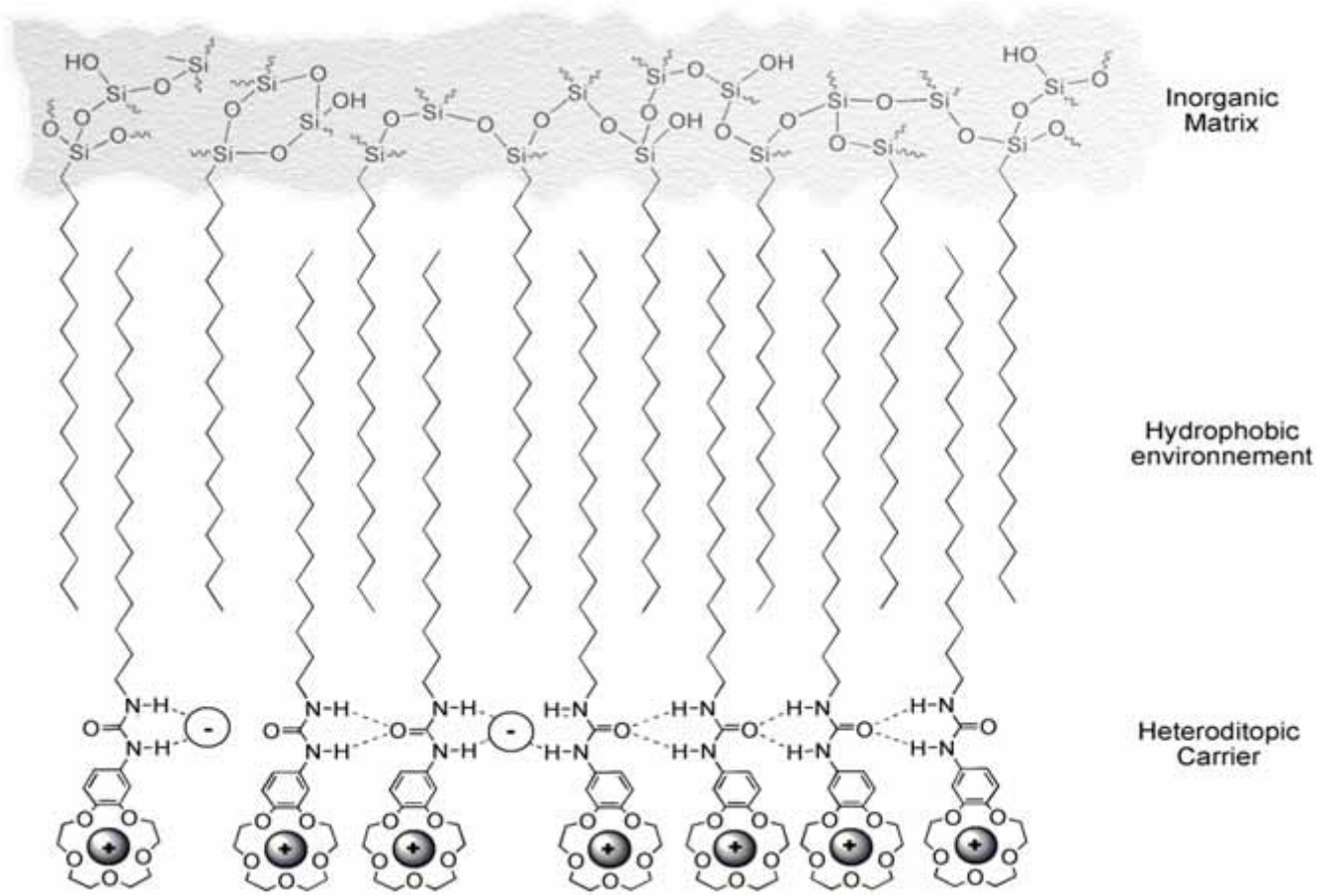






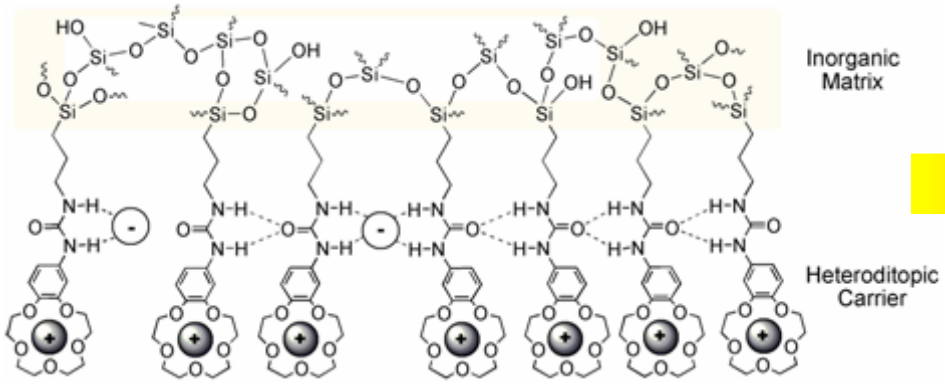
Chem. Eur.J. **2008**, *14,* 1776-1783.

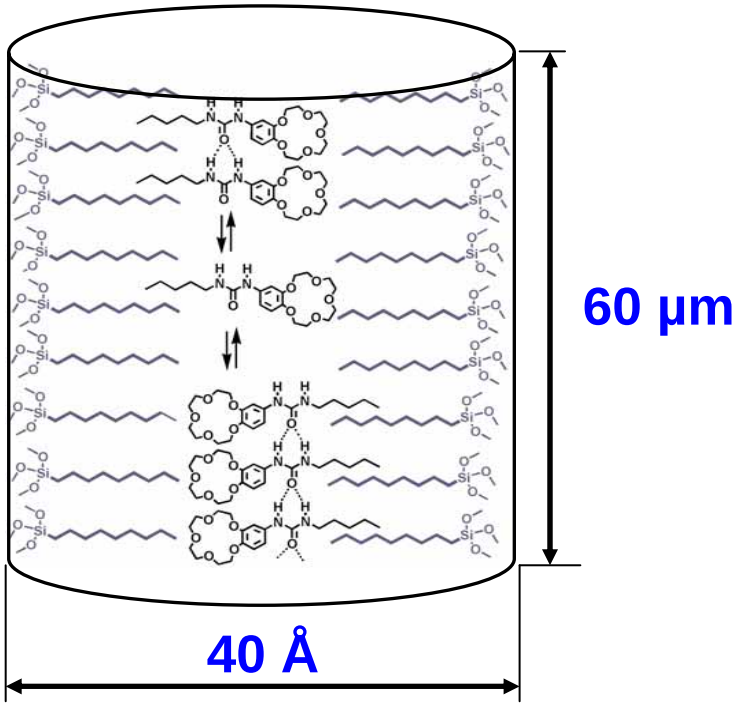
Dynamic Supramolecular Membranes



Dynamic hydrophobic transcription of self-organization in mesostructured membranes

Fluid Mosaic Model in Mesopores



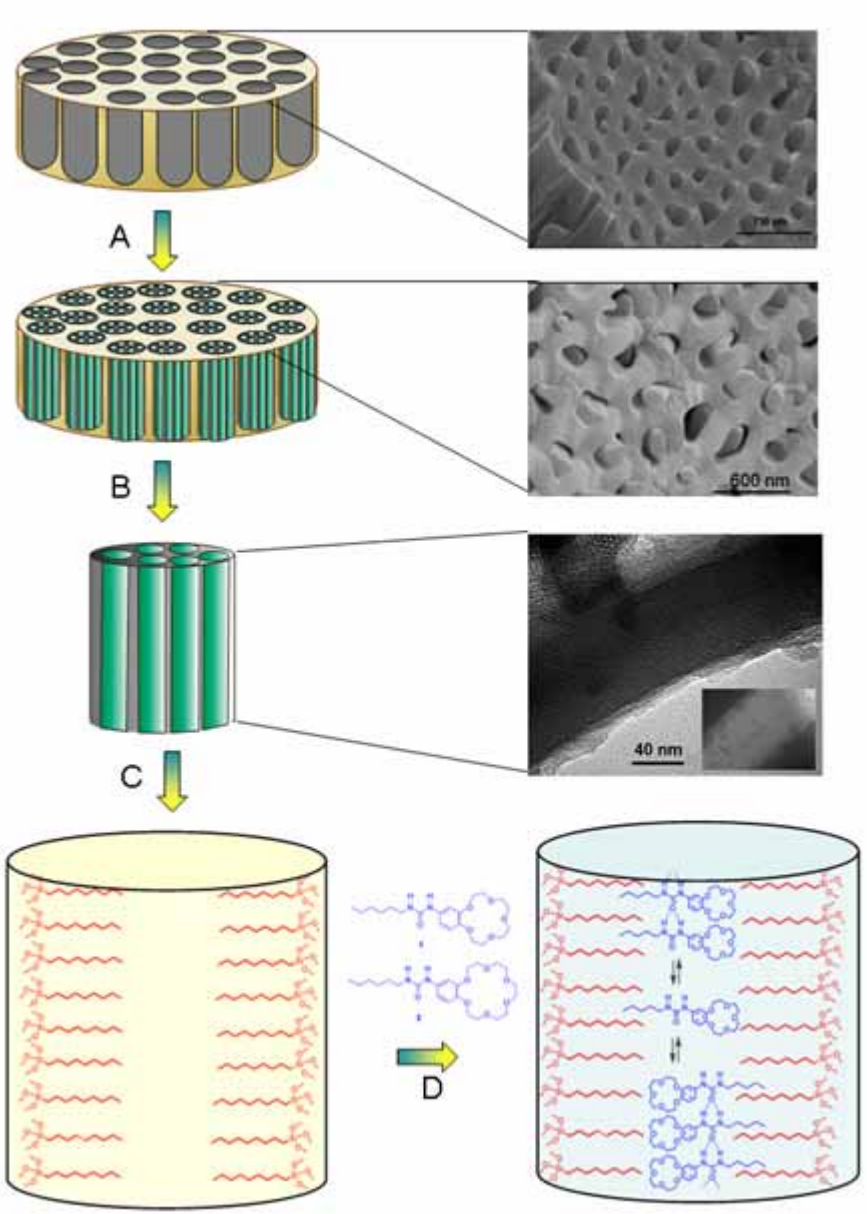


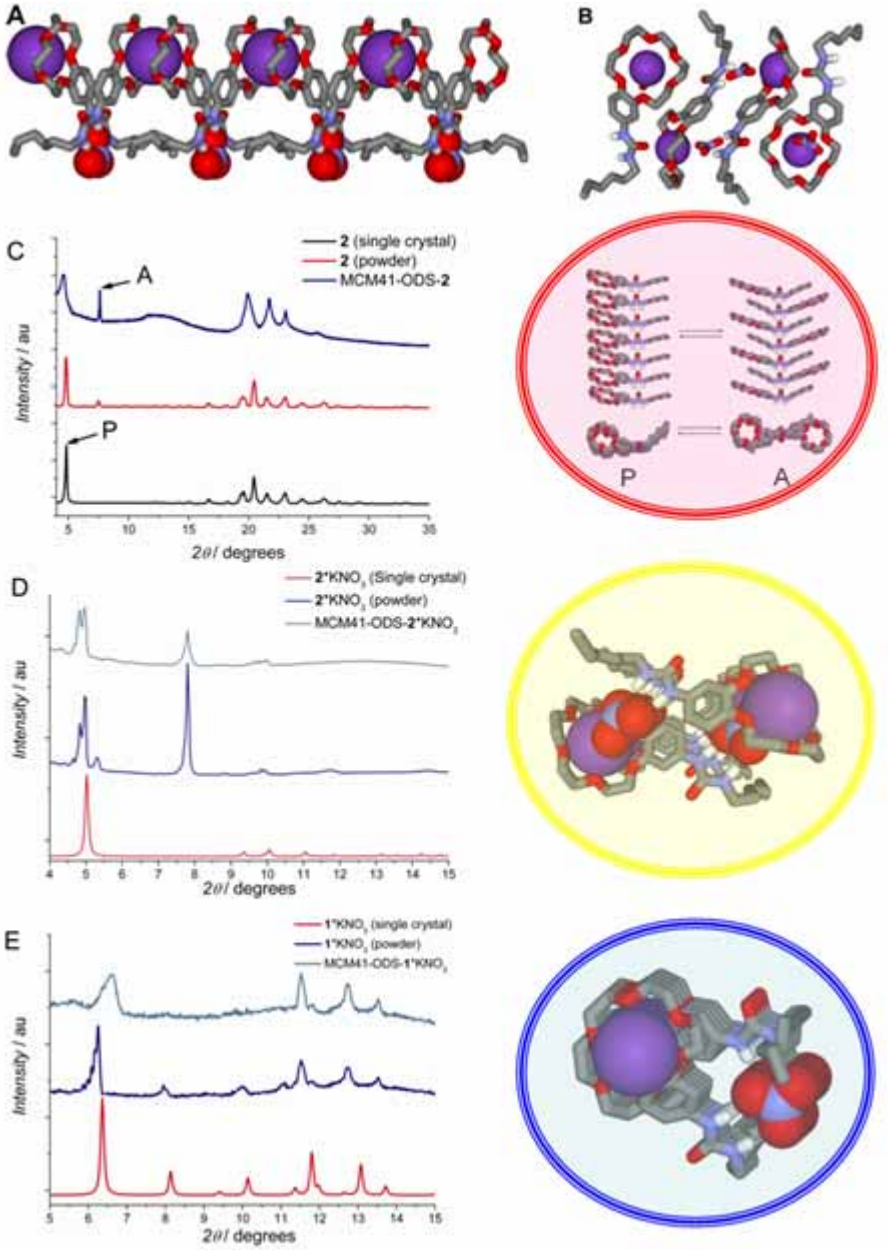
Fixed-site complexant membranes

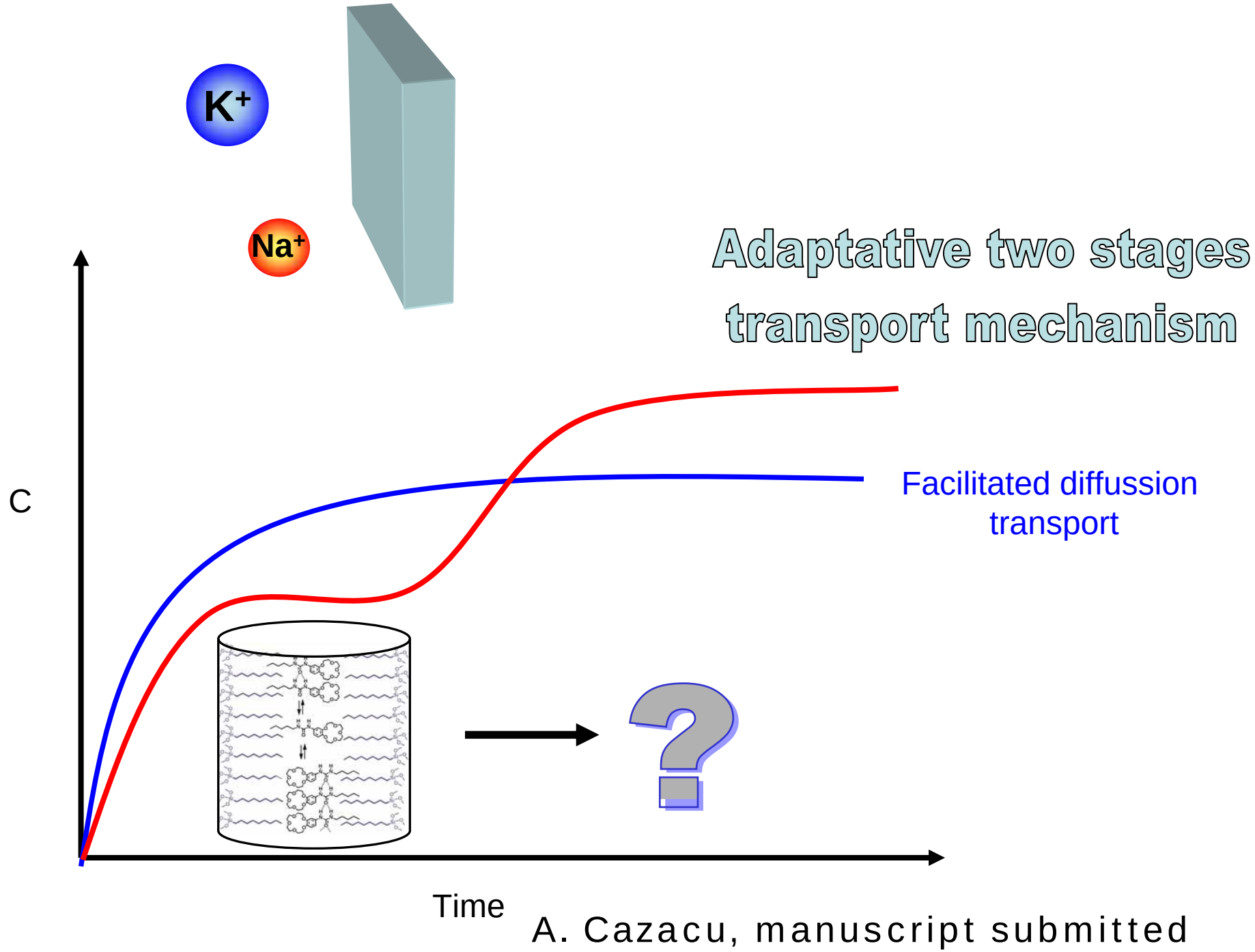
Dynamic-site complexant membranes

A Cazacu, manuscript submitted

Dynamic adaptative membranes

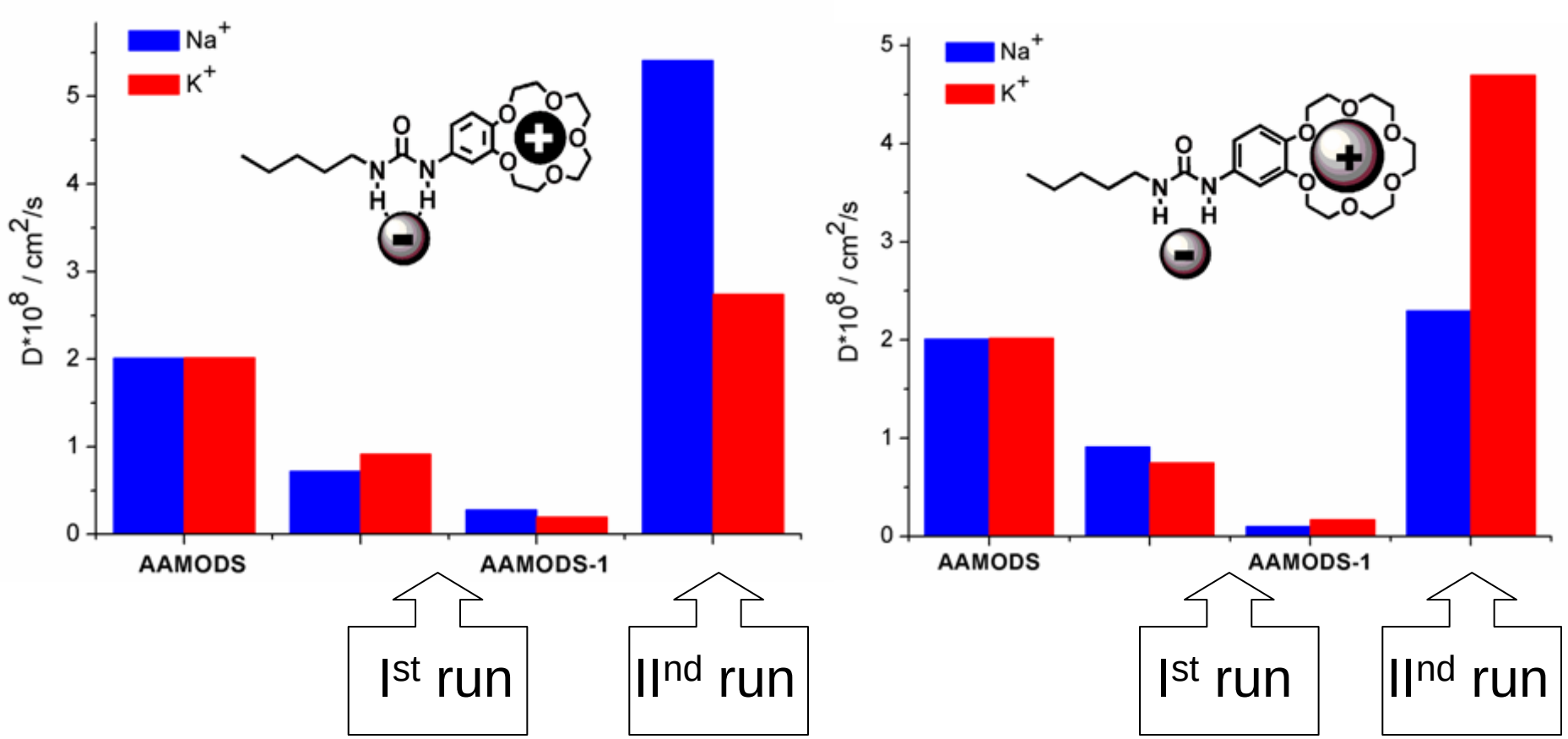


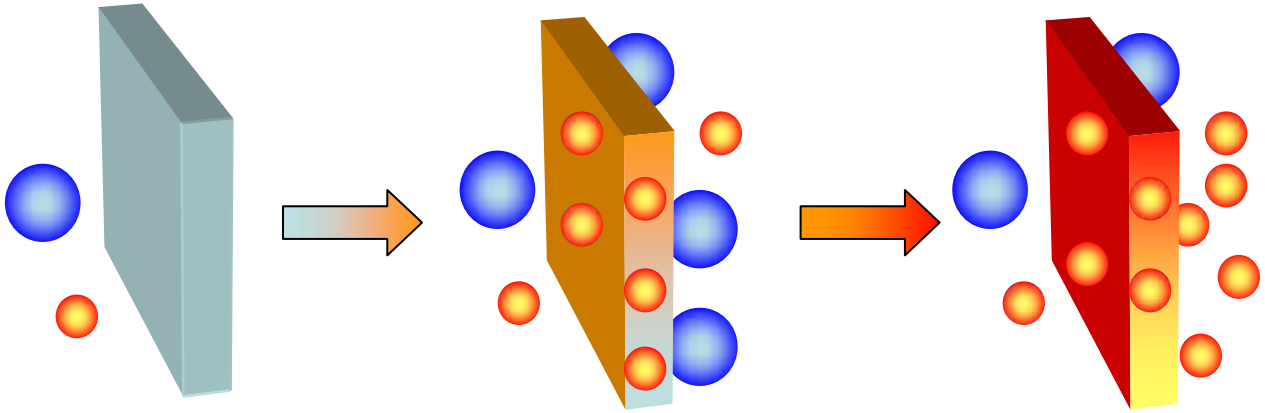




A. Cazacu, manuscript submitted

Adaptative self-organization in the mesopores

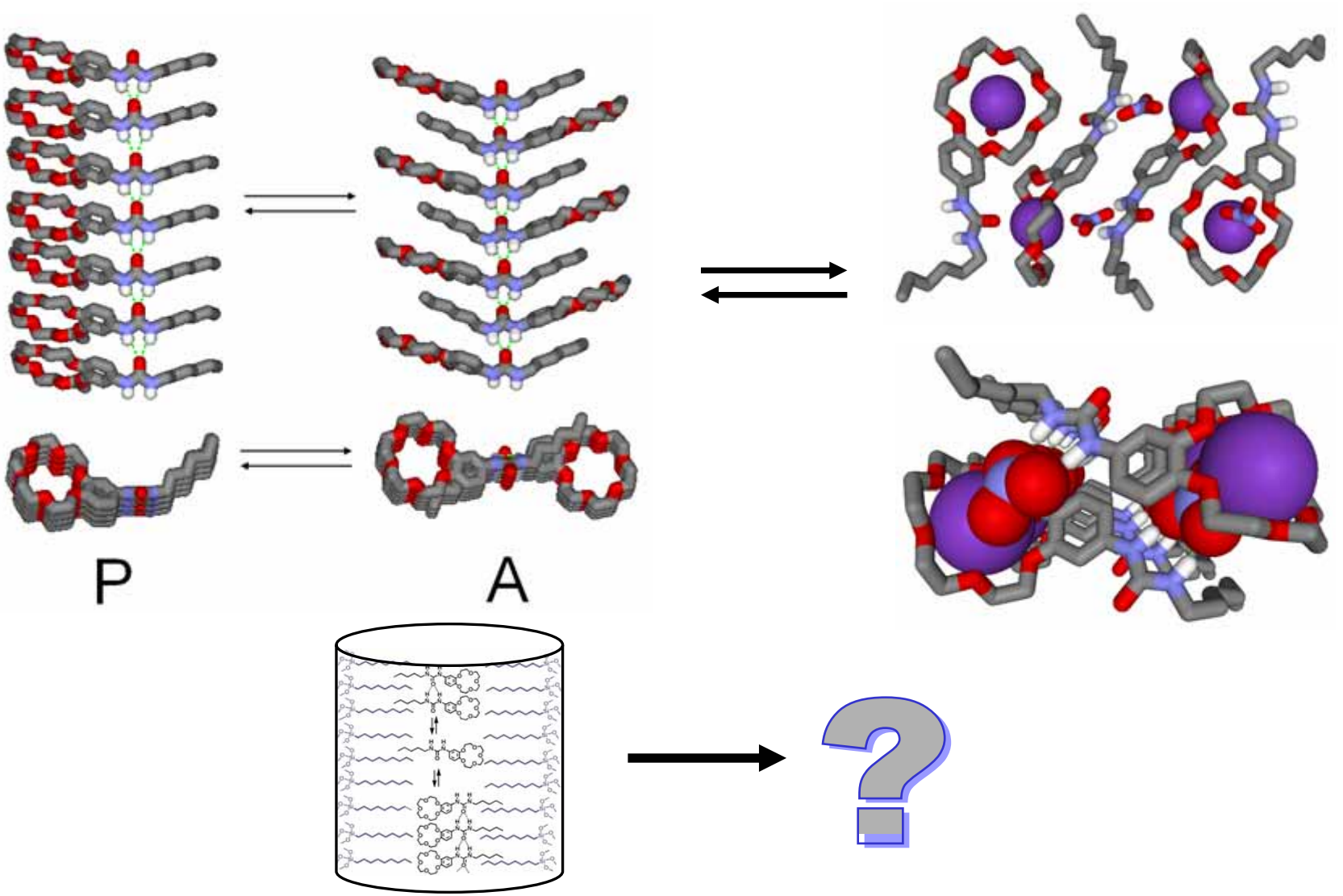




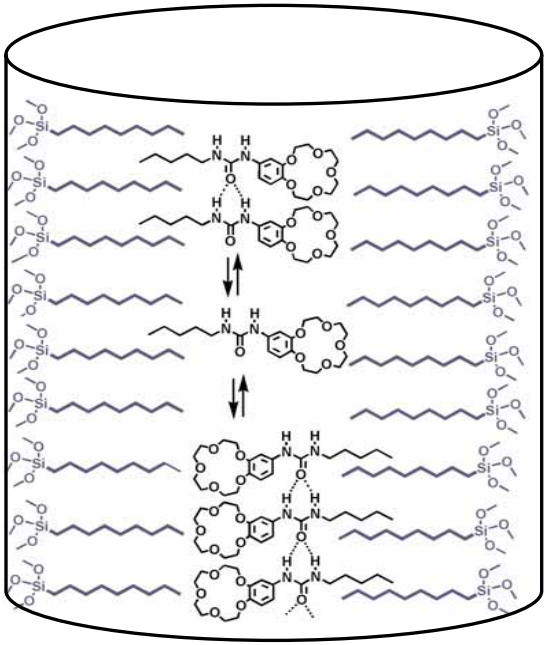
In the first step, the membrane is functioning like a "*sponge*", with the selective complexation of the fittest cation and with the membrane reorganization; it is the so-called "membrane self-preparing step.

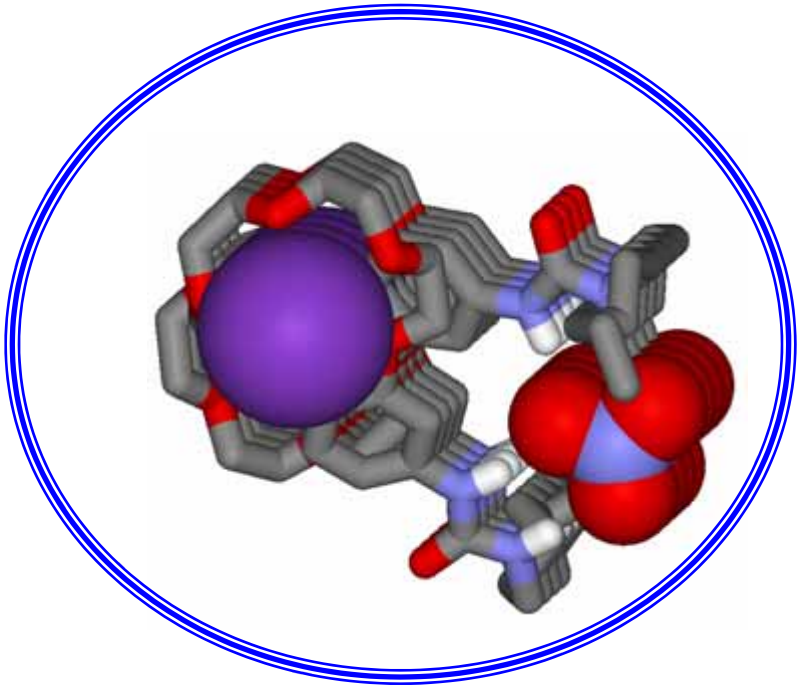
Then, a selective transport of the specific cation (Na+ for 15C5 and K+ for 18C6) occurs in the second stage, much faster; it is the so-called "membrane self-responding step - facilitated transport- SRS-FT".

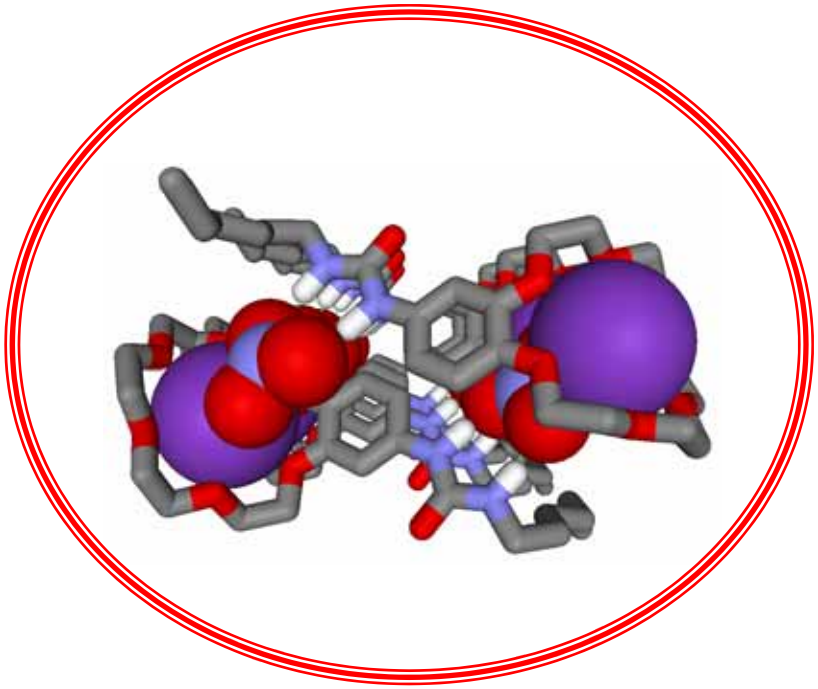
Adaptative self-organization in the mesopores



Adaptative self-organization in the presence of the solute

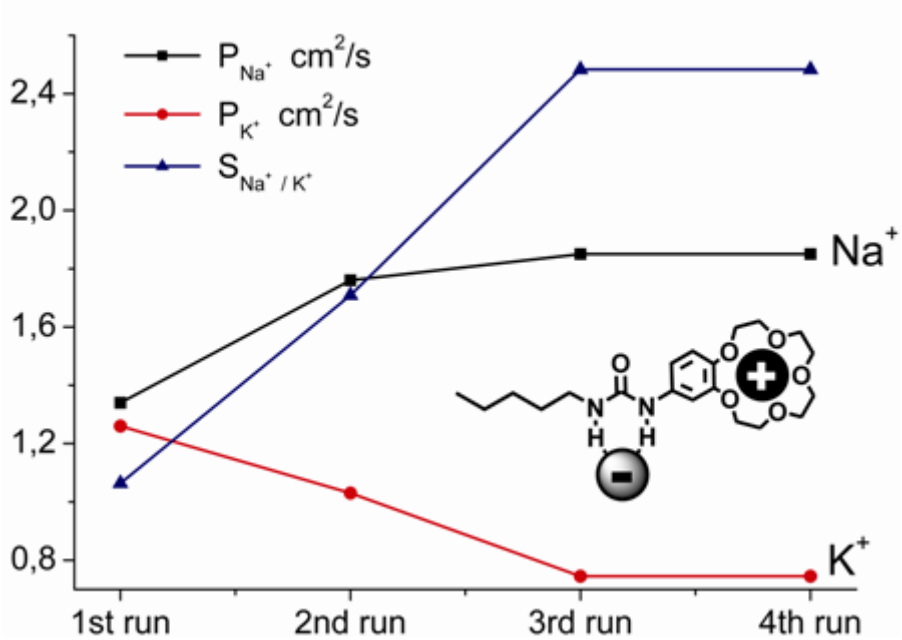


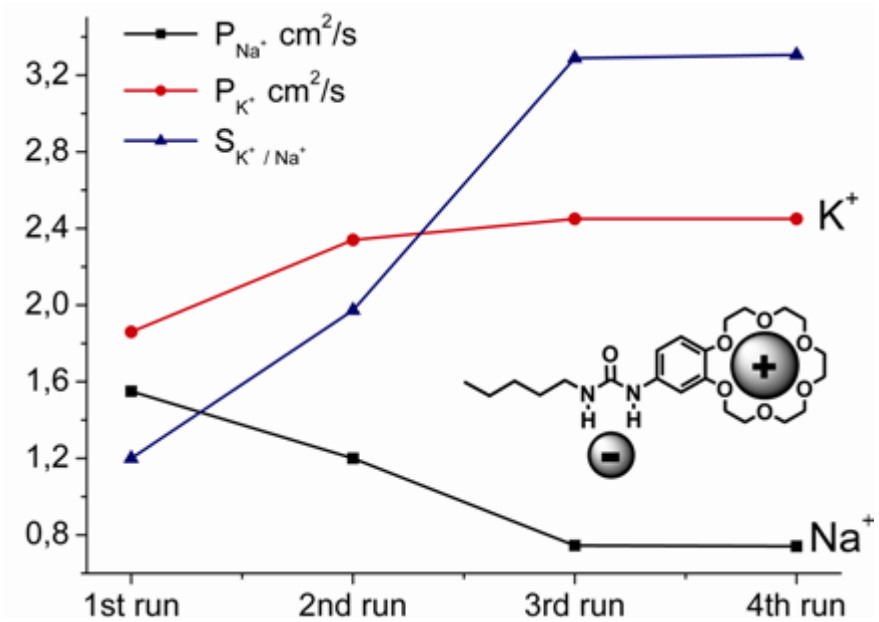




A. Cazacu, manuscript submitted

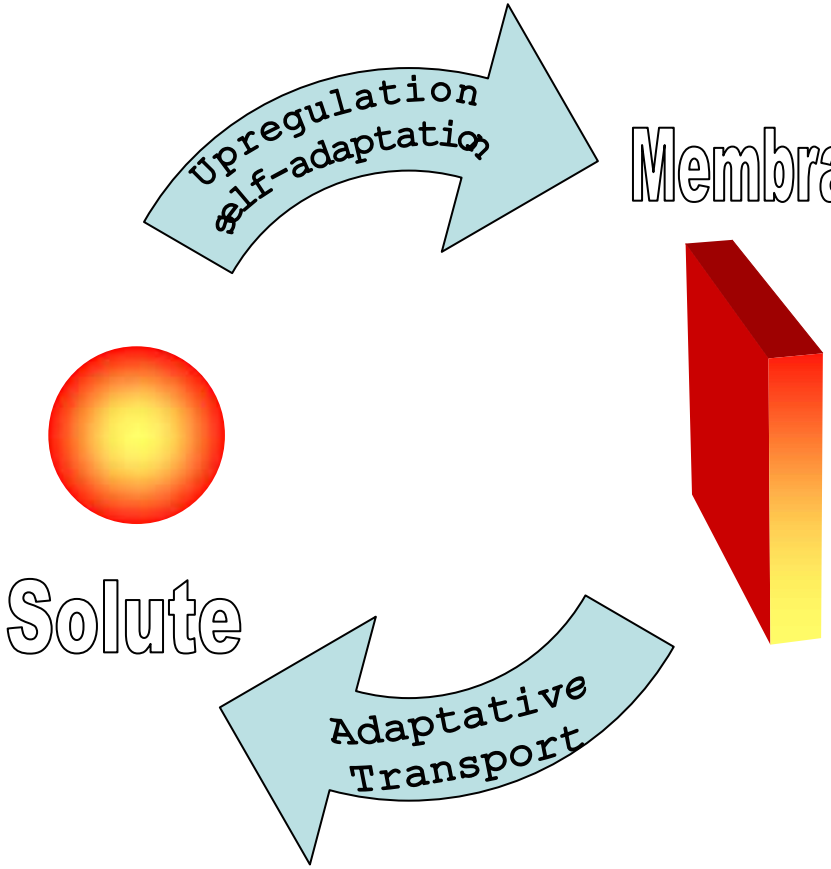
Ion-conditioned membranes





Selectivity and Permeability are both increasing

The membrane is dynamically self-instructed!

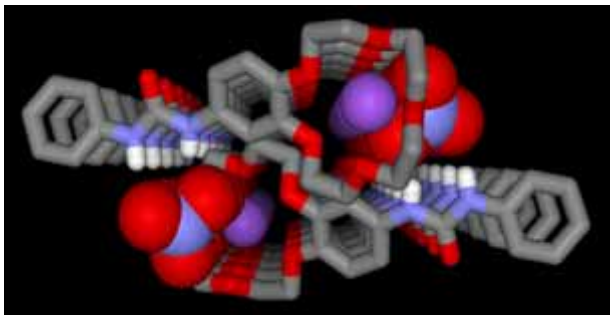


Dynamic-site complexant membranes

This concept embodies a constitutional self-reorganization (self-adaptation) of the membrane configuration producing an adaptative response in the presence of its solute.

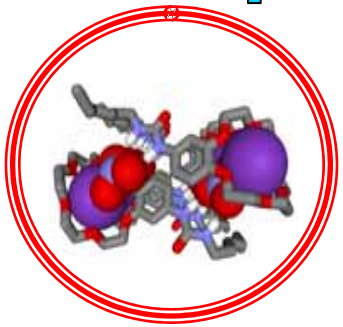
Supramolecular control of ionic conduction pathways

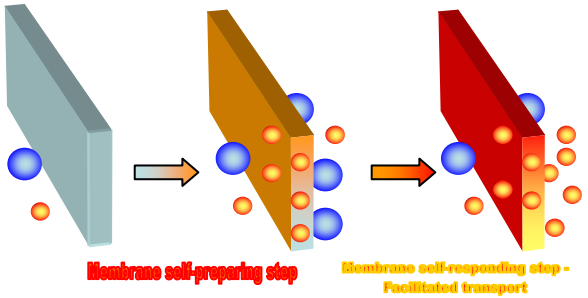
The present results show the first evidence for the possible hybrid transport carrier *vs.* channel mechanisms by solid self-organized membranes.



Constitutional control of ionic conduction pathways

A first example of dynamic “constitutional” membranes where a solute induces the upregulation of (prepare itself) its own selective membrane





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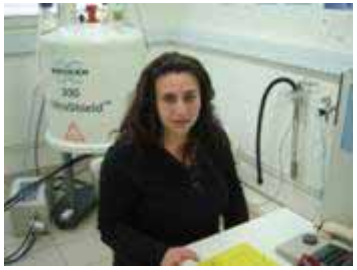
Adaptative Supramolecular Nanosystems Group











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