

# MODULATION OF LIPIDIC NANOSTRUCTURES BY DESIGNER SHORT SURFACTANT PEPTIDES

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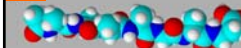
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## Designer Amphiphilic Peptides: Short Cationic & Anionic Lipids

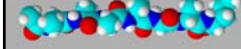
A<sub>6</sub>D



A<sub>6</sub>D (anionic surfactant):

Acetyl-Ala-Ala-Ala-Ala-Ala-Ala-Asp-COO<sup>-</sup>

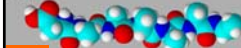
A<sub>6</sub>K



A<sub>6</sub>K (cationic surfactant):

Acetyl-Ala-Ala-Ala-Ala-Ala-Ala-Lys-CONH<sub>2</sub>

DA<sub>6</sub>



KA<sub>6</sub>



- Tuneable nanobiomaterials & novel surfactants
- Similar to biological phospholipids
- "Peptergents"
- Self-assembling behavior

## Peptides Self assembly: Formation of Nanotubes and Nanovesicles



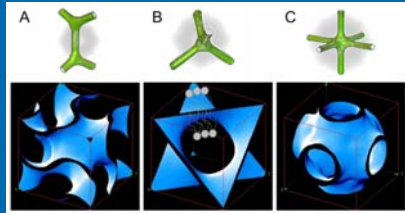
- Self-assembly
- The nanostructure diameter  $\approx$  50-100 nm

Vauthey et al. *PNAS* 2002 & Maltzahn et al. *Langmuir* 2003

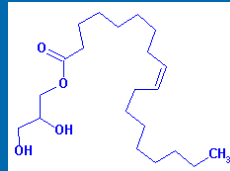
## Our Motivation:

- A new strategy for the encapsulation of bioactive materials
- Understanding lipid-surfactant peptide interactions
- Controlling self-assembled nanostructures
- Designing New Drug Nanocarriers

## The Binary Monoolein (MO)-Water System

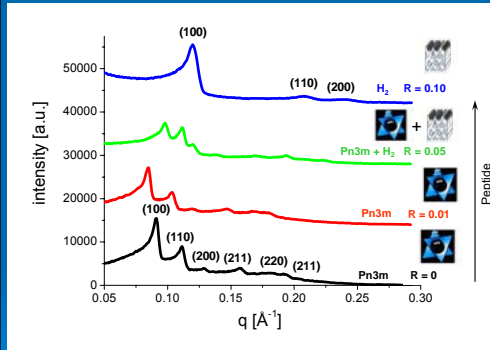


Monoolein (MO):

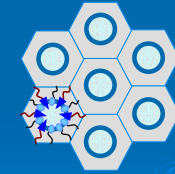


$V_2$  assemblies:  
*la3d* (the gyroid type), *Pn3m* (diamond type), & *Im3m* (the primitive type) symmetries

## The Anionic Surfactant $A_6D$ Peptide



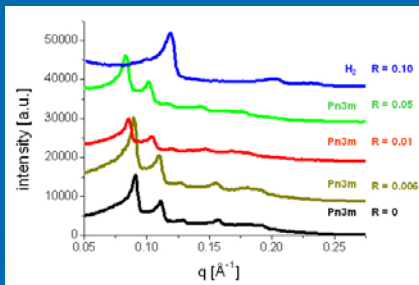
SWAXS System 3:  
Hecus X-ray Systems  
(Austria)



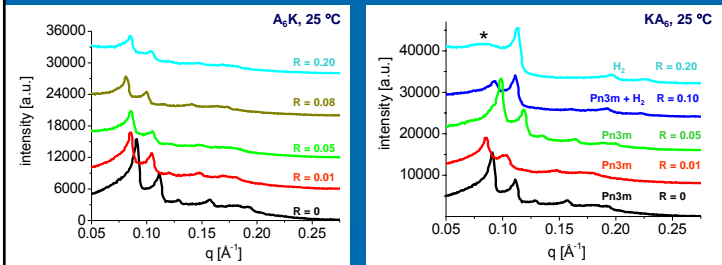
$$l_{max} - l_{min} = a \left( \frac{1}{\sqrt{3}} - \frac{1}{2} \right) = 0.07735 \cdot a$$

- Control self-assembled structures
- The structure depends on the peptide's concentration
- Functionalization of *Pn3m* phase

## The Anionic Surfactant $DA_6$ Peptide

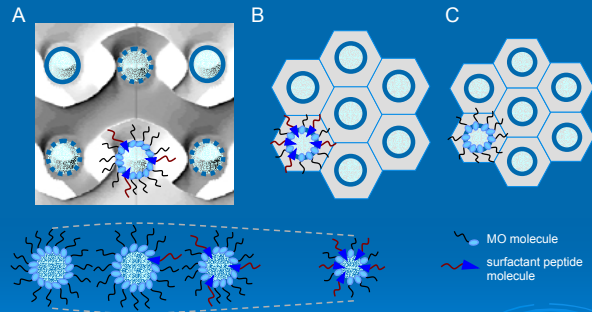


## The Cationic Surfactant Peptides



- Headgroup location & the effectiveness of designer surfactants

## Schematic Cartoon for the Incorporation of Surfactant Peptides



## Conclusions

- **Positive & negative designer surfactant peptides:** modulating the structure by adding short peptides
- **Structural transformations:** providing *functionalized* crystalline phases at low peptide's content & inducing the transition Pn3m to H<sub>2</sub>
- **The headgroup impact:** learning the important role of the headgroup location & its structure
- **Potential applications:** *functionalizing* liquid crystalline phases. A practical route for enhancing the loading capacity of active molecules

Yaghmur et al. (2007) *PLoS ONE* 2, e479  
Freely available online

