SELF-ASSEMBLY OF DENDRIMERS AND MACROCYCLES INTO FIBRILLAR STRUCTURES

An Ver Heyen[α], **S. De Feyter**[α], **S. Höger**[β], **K. Müllen**[γ], **F. C. De Schryver**[α]

[α] K.U.Leuven, Department of Chemistry, Molecular and Nanomaterials, Celestijnenlaan 200F, 3001 Heverlee, Belgium; [β] Institut für Technische Chemie und Polymerchemie, Engesserstr. 18, 76131 Karlsruhe, Germany; [γ] Max-Planck Institute for Polymer Research, Ackermannweg 10, 55128 Mainz, Germany

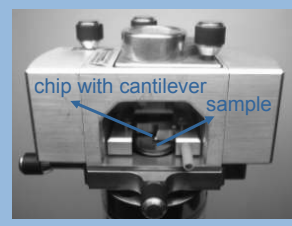
e-mail: An.VerHeyen@chem.kuleuven.ac.be

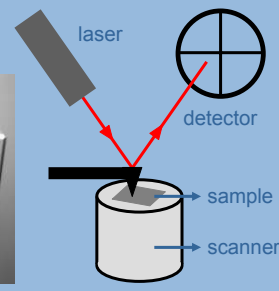
INTRODUCTION

- Goal: surfaces with specific properties
- Method
  - scanning probe microscopes
  - self-assembly: process in which particles organise spontaneously to form more complex structures
    - molecule: symmetry, functional groups; solvent; concentration; substrate with / without patterns; sample preparation

METHOD

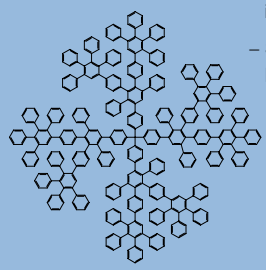
- Atomic Force Microscopy
  - topography
  - force interactions
  - sharp tip





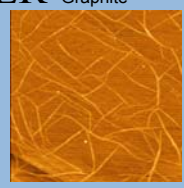
RESULTS: DENDRIMER

- 2nd generation polyphenyl dendrimer
  - Structure



  - Dissolves in THF
  - Sample preparation:
    - drop casting in THF saturated tank
    - AFM images: 10 × 10 μm², 2.17 × 10^{-5} M

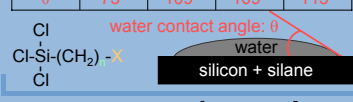
Graphite



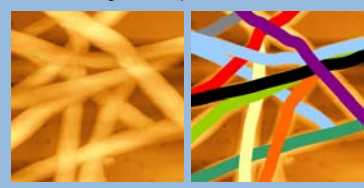
Silicon

- silicon substrates covered with silanes

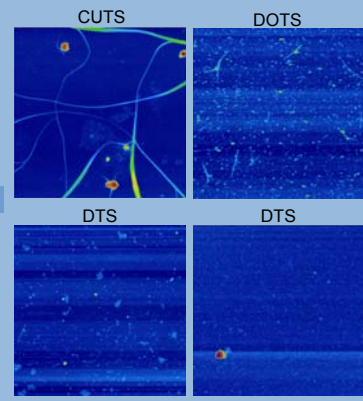
Silane	CUTS	DOTS	HDTS	DTS
n	11	22	16	10
X	-CN	$-CH_3$	$-CH_3$	$-CH_3$
θ	73°	109°	109°	115°



- AFM image: 2 × 2 μm², 2.17 × 10^{-5} M

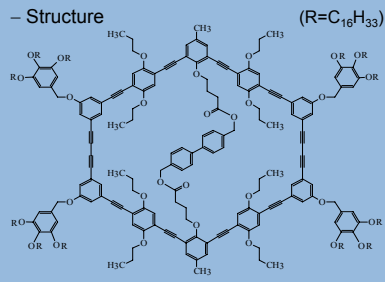


- AFM images: 7×7 μm², 1.09 × 10^{-5} M



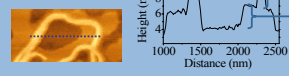
RESULTS: MACROCYCLE

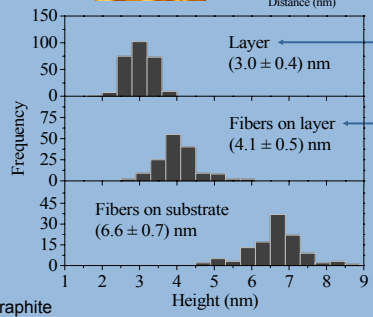
- Ring structure with biphenyl bridge inside the ring
  - Structure (R=$C_{16}H_{33}$)



  - Dissolves in TCB
  - Sample preparation:
    - drop casting

- Line profile





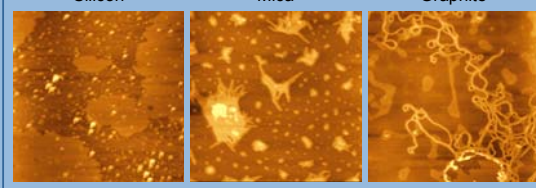
  - Histograms:
    - 1.17 × 10^{-4} M on graphite

(3.0 ± 0.4) nm + (4.1 ± 0.5) nm = (7.1 ± 0.9) nm → 7.1nm ∈ (6.6 ± 0.7) nm

Sum 'mean height layer' plus 'mean height fibers on layer'

- AFM images: 7 × 7 μm², drop casting 1.17 × 10^{-4} M

Silicon Mica Graphite



- AFM images: 2 × 2 μm², drop casting on graphite

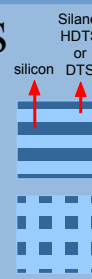
1.13 × 10^{-6} M 1.12 × 10^{-5} M 1.17 × 10^{-4} M

CONCLUSION

- DENDRIMER
  - Parameters of fiber formation are optimised
    - Solvent / concentration: 2.17 × 10^{-5} M in THF
    - Substrate: silicon
    - Sample preparation: drop casting in THF-tank
  - Mechanism of fiber formation
    - Fibers form on substrate, though initiated in solution
- MACROCYCLE
  - Parameters of fiber formation are optimised
    - Solvent / concentration: 1.17 × 10^{-4} M in TCB
    - Substrate: graphite
    - Sample preparation: drop casting
  - Mechanism of fiber formation
    - The molecules do not form fibers directly on the substrate, but form incomplete layers on which fibers can be formed
    - Biphenyl plays important role in self-assembly

FUTURE PLANS

- DENDRIMER
  - Controlling the fiber formation with substrate modification
    - Fibers do not form on HDTS, nor on DTS covered silicon
    - Patterns will be made with micro contact printing using these silanes as ink molecules



- OTHER MOLECULES