

**Christian Collette**  
*Vice President Research and Development*  
*Arkema, Paris, France*

**Biography**

Phd in 1986 Polymer Sciences University Pierre et Marie Curie PARIS.

1987 Post Doc in Santa Barbara University.

Joins the ELF AQUITAINE Group in 1987.

Head of Research and Development of ARKEMA since end of 2004  
(date of creation of the company).

Member of French Chemical Society.

Member of National Research Agency.



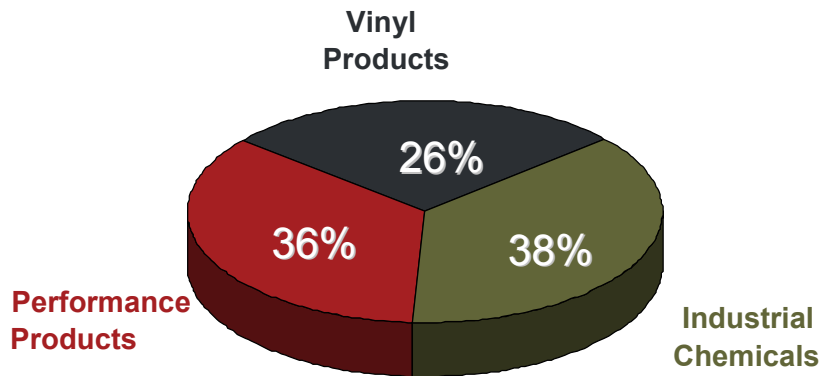
# **“Arkema R&D in Support of Innovation and Growth”**

**Christian Collette  
VP R&D  
Arkema, Paris, France**

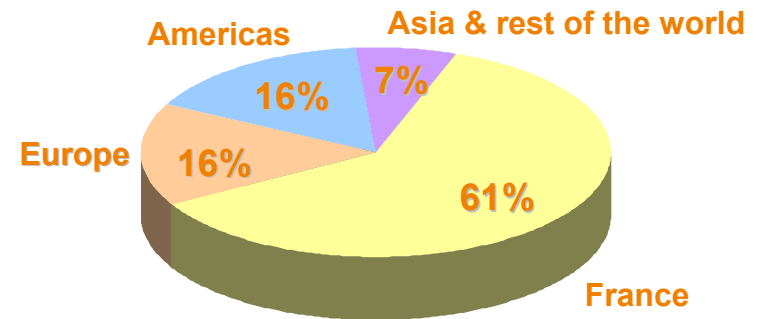
2005 Management Conference,  
AIChE & ACS, Cincinnati, OH  
November 3-4, 2005

# Arkema, a World-Scale Chemicals Manufacturer

- Annual sales of 5.2 billion euros
- 120 locations around the world
- Present in 40 countries



Breakdown of Sales



Breakdown of Personnel

- 18,600 employees
- 90 plants
- 6 research centers

# Three Balanced and Coherent Business Segments

## Vinyl Products

Chlorochemicals  
& PVC

Vinyl Compounds

Pipes & Profiles  
(Alphacan)

## Industrial Chemicals

Acrylics

PMMA (Altuglas  
International)

Thiochemicals

Fluorochemicals

Hydrogen Peroxide

## Performance Products

Technical Polymers

Specialty Chemicals  
(CECA)

Organic Peroxides

Additives

Urea Formaldehyde  
Resins

Agrochemicals  
(Cerexagri)

# Development Areas



# R&D, The Spearhead of Innovation

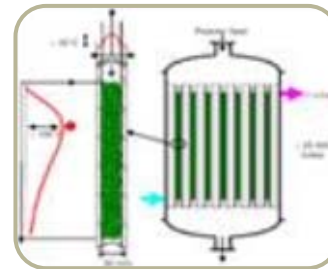
- **Over 3% of sales** allocated to research
- **1,400 researchers, 150 patents** registered every year
- **6 research centers:** **Cerdato** in Serquigny / France, **CRRA** in Pierre-Bénite / France, **CRDE** in Carling / France, **GRL** in Lacq / France, **King of Prussia** in Philadelphia / USA, **KTC** in Kyoto / Japan



**Nanotechnologies**



**Marine Paints**

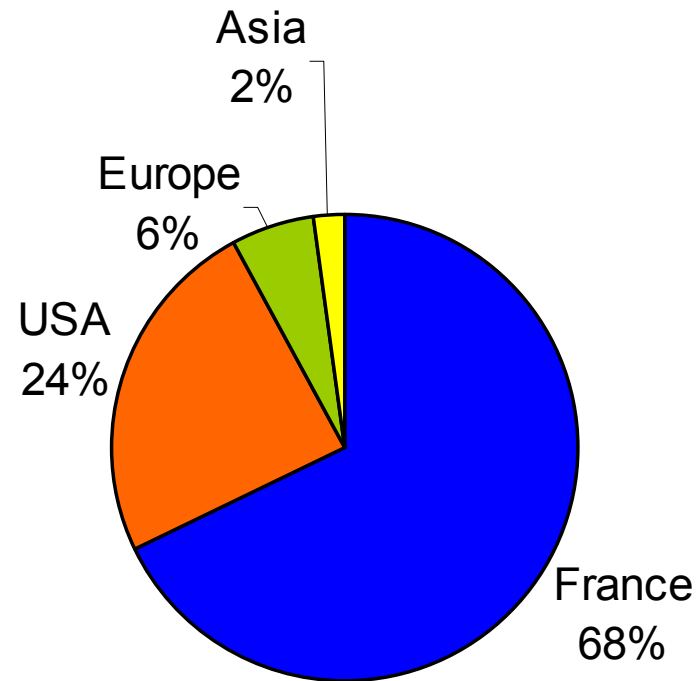


**Acrylic Processes**



**Fuel Cells**

# Geographical Split



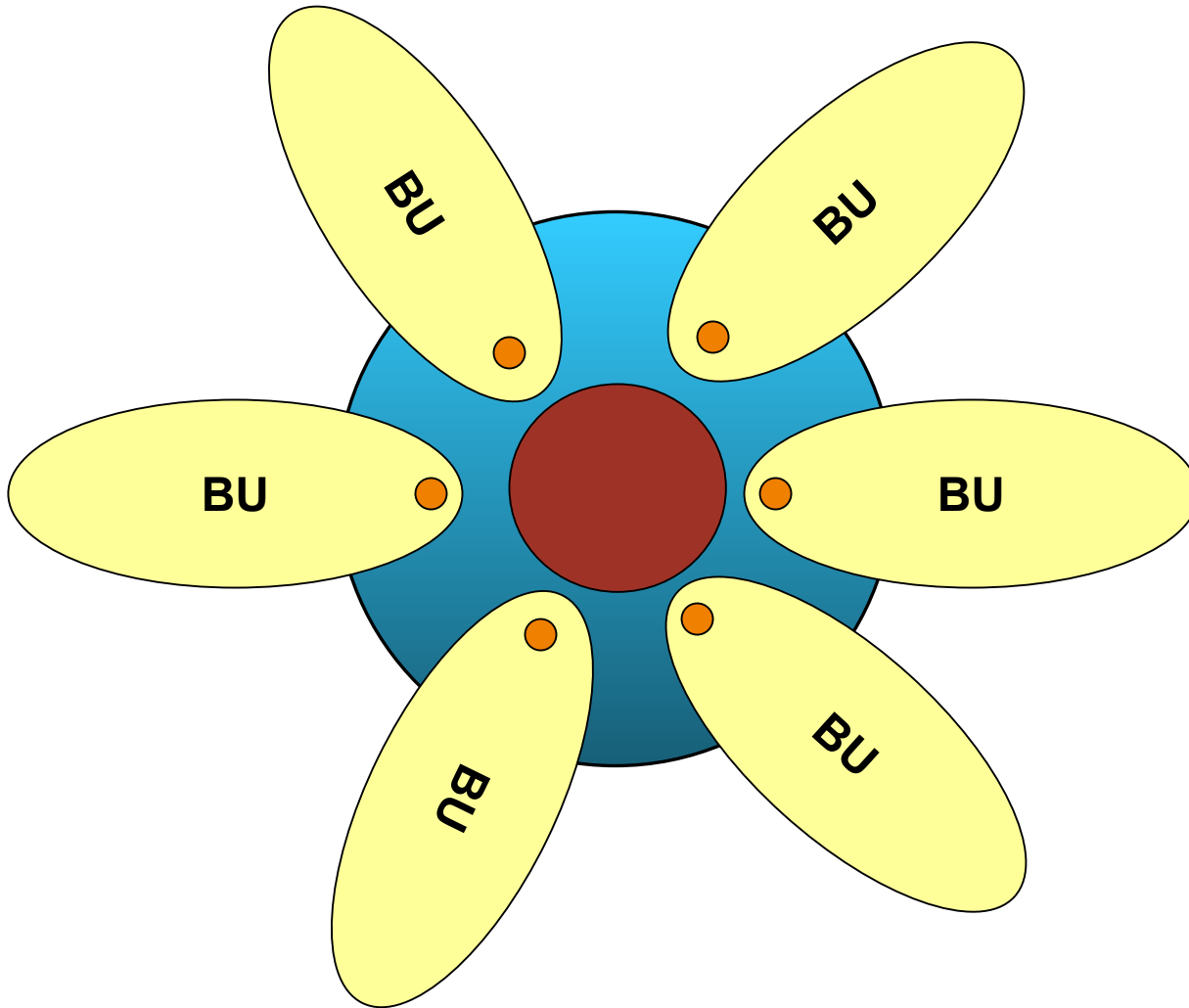
TOTAL: 185 M€

# Central R&D

- In charge of the corporate program (12% of global R&D budget)
- Answerable for the scientific and technological pertinency of the strategic BU's projects
- Intellectual property department
- Hierarchical authority over research centers
- Management of the worldwide academic relations and contracts



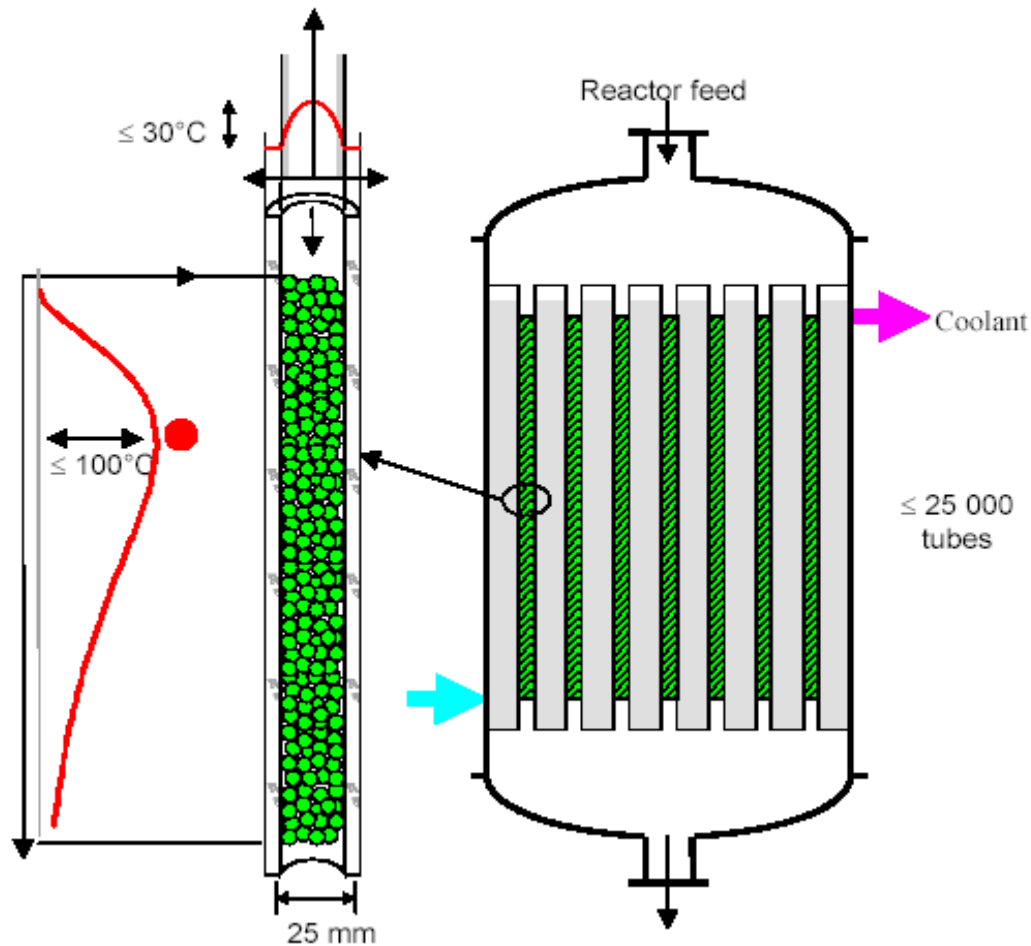
# R&D Organization



## MISSIONS

- . Exploit Inter-BU **Synergies**
- . Develop/Maintain **Critical Competencies**
- . Manage Efficiency of **Resources**
- . Assure Long-Term **Sustainable Innovation**

## Temperature profiles in multitubular reactors



**Hot Spot** determines:

- conversion
- selectivity
- catalyst lifetime
- reactor safety
- reactor materials

# Acrylic Acid Processes (from Propylene or Propane)

Acrolein reactor fabrication



Number of tubes: > 27.000

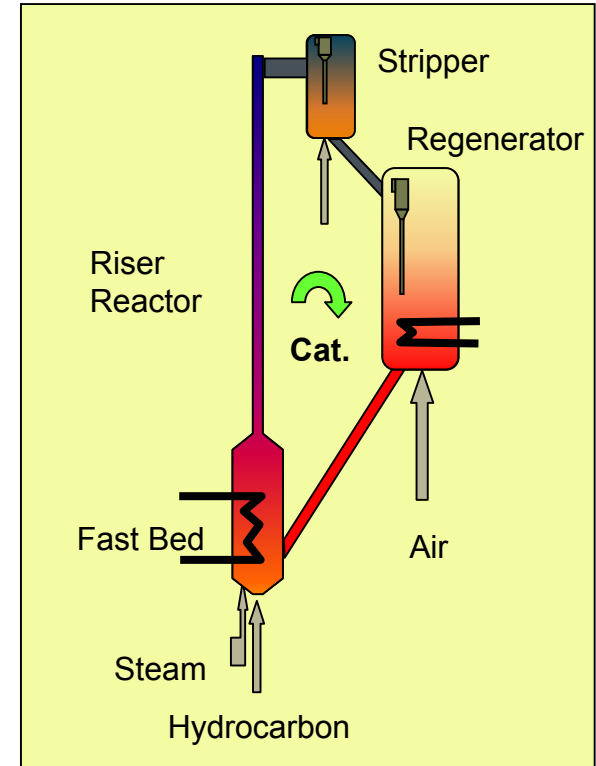
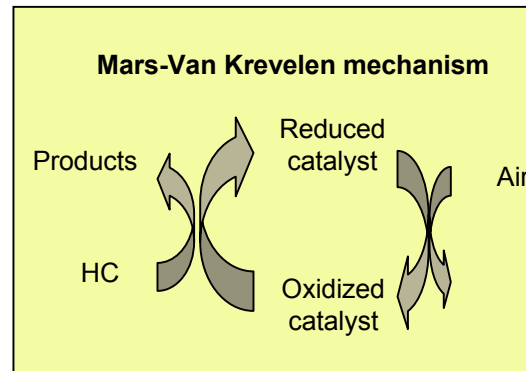
Weight: 350 MT

**Acrylic acid reactor**



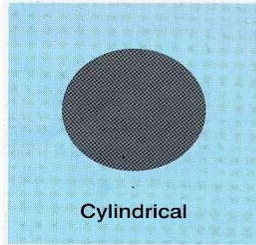
Number of tubes > 27.000

Weight: 570 MT

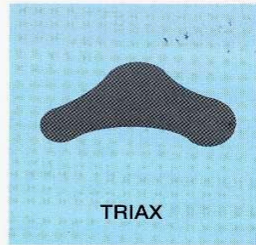


Circulating Fluid Bed Process  
DuPont-Arkema 'Riser'  
Technology

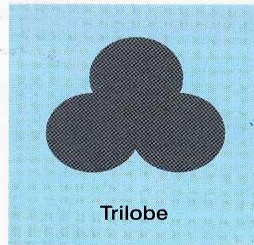
# TREATING OF NAPHTHA & DISTILLATE



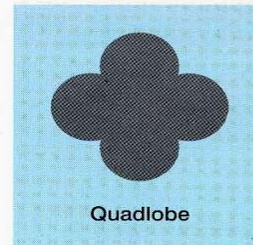
Cylindrical



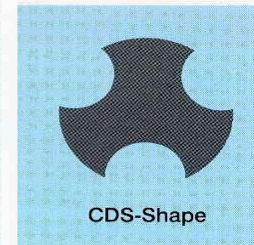
TRIAX



Trilobe



Quadlobe



CDS-Shape

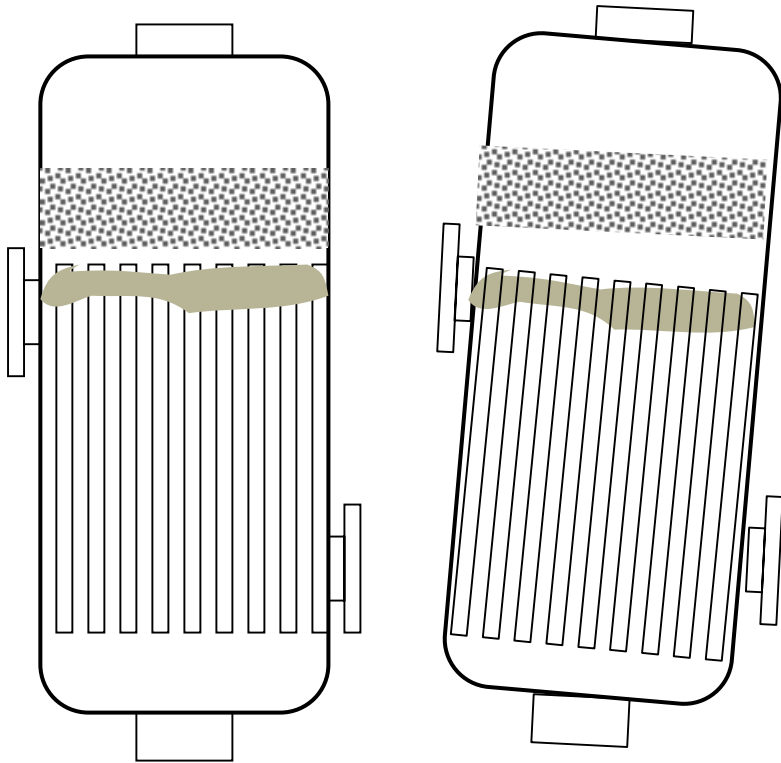
Available shapes for hydroprocessing catalysts

Süd-Chemie



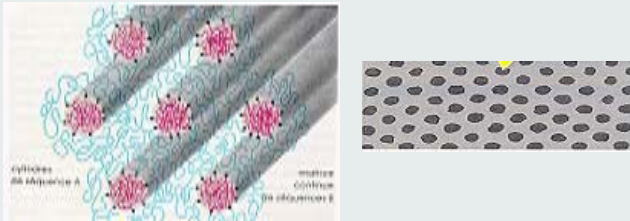
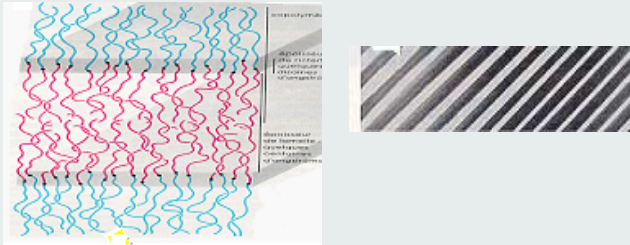
# Formaldehyde Reactor: Silver Process

- Tilted reactor

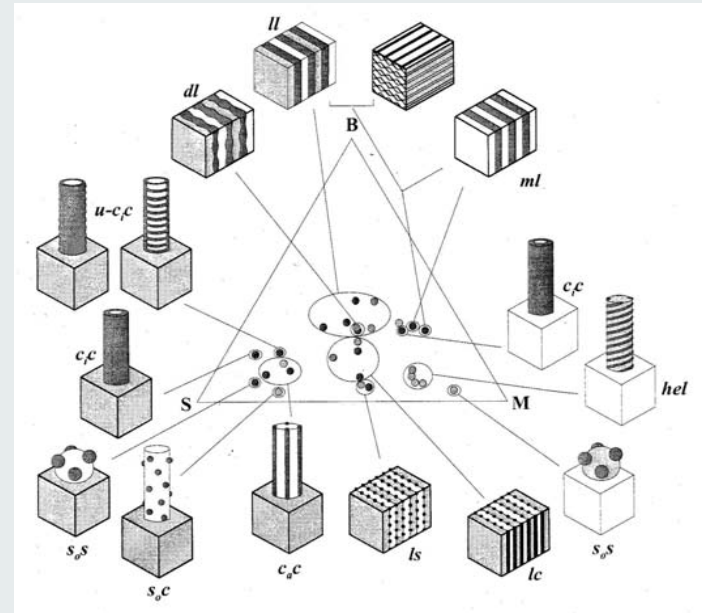


# Block Copolymers are “Self-Assembling” Systems

## AB diblock copolymers



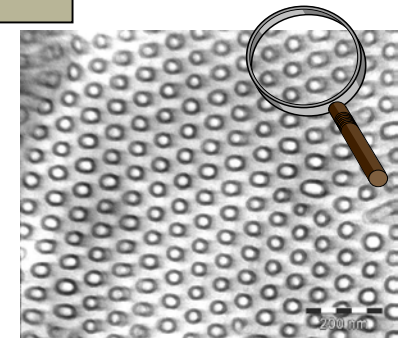
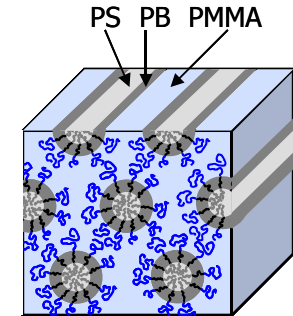
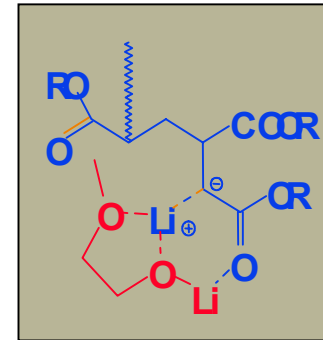
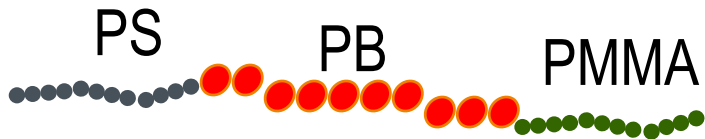
## ABC triblock copolymers



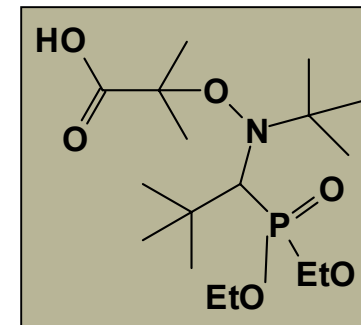
SELF-ASSEMBLY → NANOSTRUCTURES  
Spontaneous organization @ nanometer scale

# Living Polymerization Technologies: Towards Nanostrength®

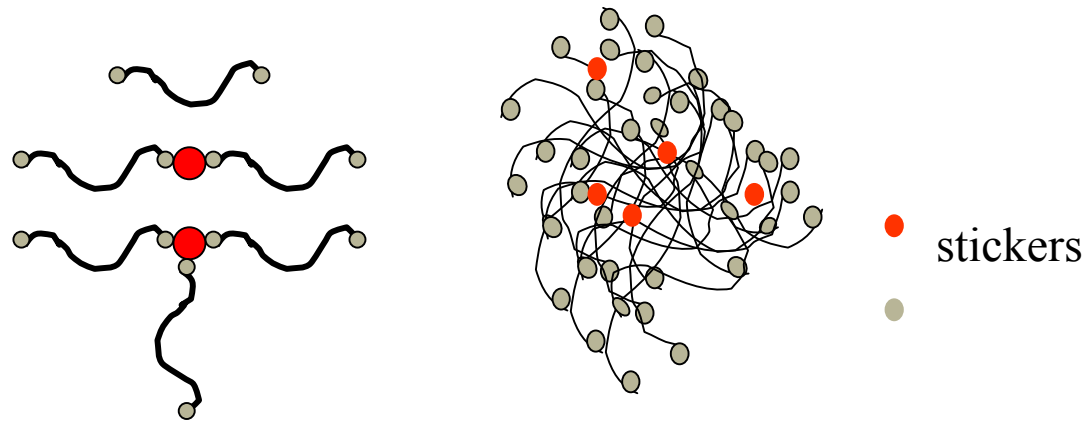
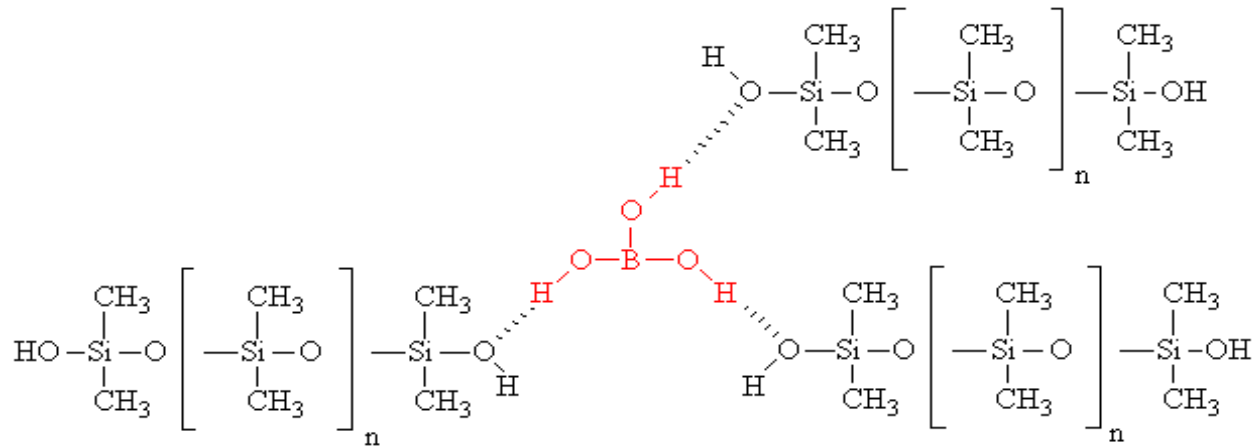
- Anionic Polymerization of Methacrylates



- Nitroxide-mediated Radical Controlled Polymerization

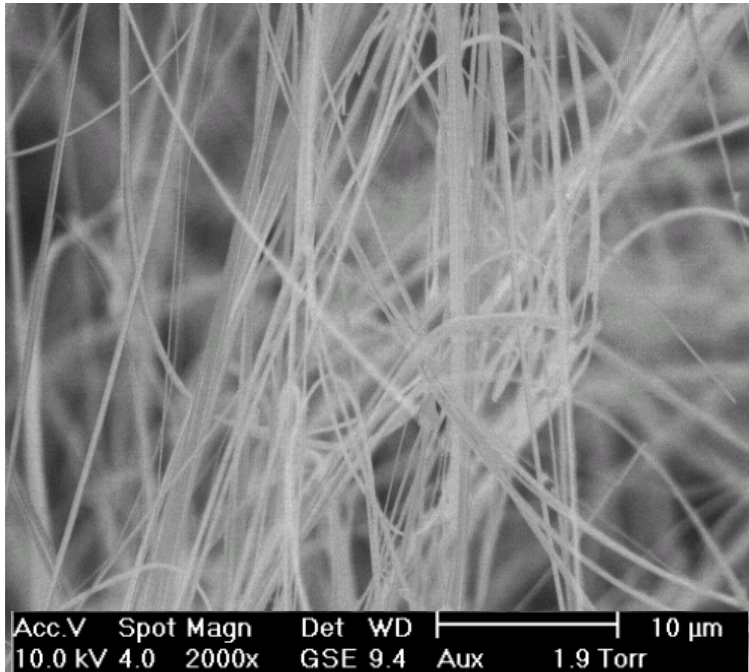


# Silly Putty: “Supramolecular Chemistry”



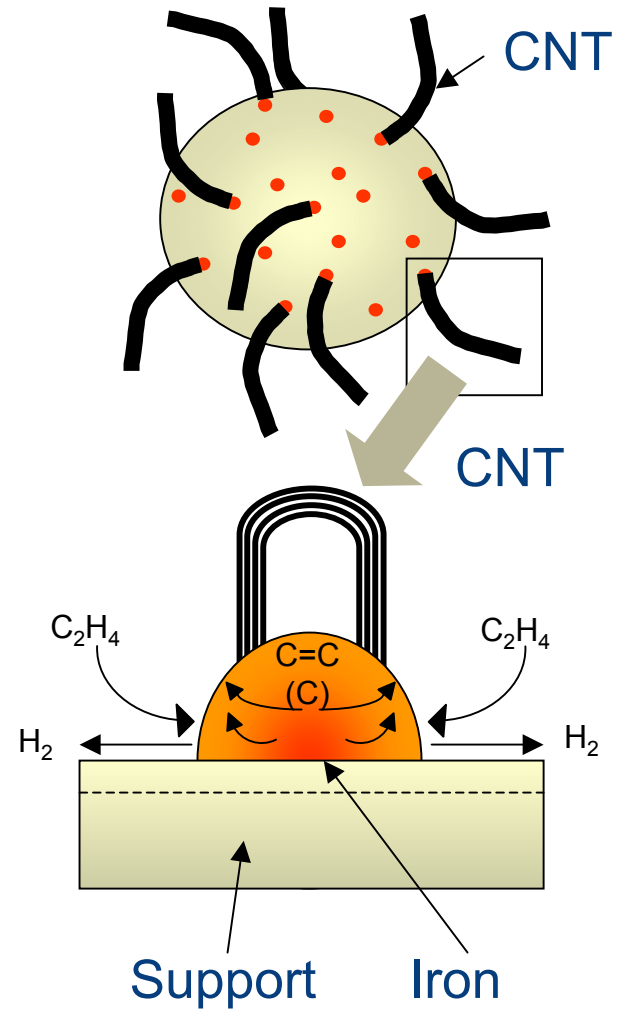
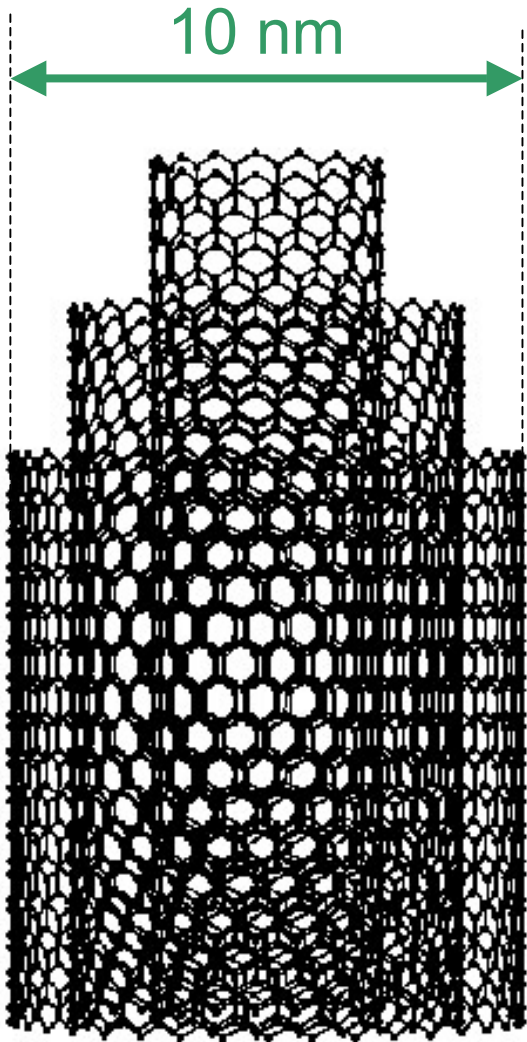


# S.E.M. of CNT



<b>Diameter:</b>	1 to + 10 nanometers
<b>Length::</b>	1 to + 10 <sup>2</sup> microns
<b>Morphology:</b>	Graphitic sheet
<b>Density :</b>	2,0 g / cm <sup>3</sup>
<b>Spc. surface:</b>	100 - 250 m <sup>2</sup> / g
<b>Color:</b>	Black
<b>Electronic:</b>	Metallic or semi- conductive
<b>Modulus:</b>	Young's modulus +1TPa
<b>Heat Transmission:</b>	Equivalent to diamond

# CNT Growing



# MEA Function

