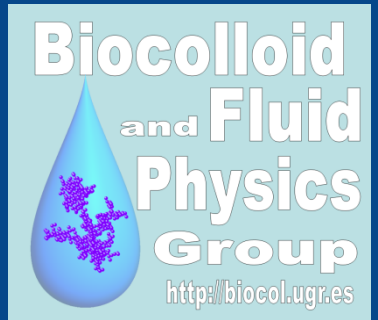




UNIVERSIDAD  
DE GRANADA

Grupo de investigación FQM-115:

# *Física de Fluidos y Biocoloides*









22 Doctores y 6 PIF

<http://biocol.ugr.es>



## Investigación multidisciplinar tanto básica como aplicada en *Ciencia de Coloides e Interfases* con estrecha y dilatada colaboración con la industria

**COLOIDE:** Dispersión de una sustancia de  $10^{-6}$ - $10^{-9}$  m (1  $\mu\text{m}$  - 1 nm) (fase dispersa) en un medio (fase continua). Gran aplicación industrial y biomédica.

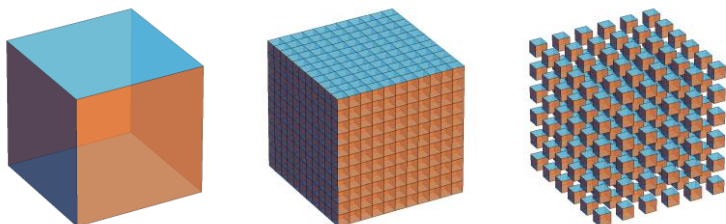
Fase continua	Fase dispersa	GAS	LÍQUIDO	SÓLIDO
GAS		No es posible	<b>Aerosol líquido</b> (niebla, sprays)	<b>Aerosol sólido</b> (Humo, polvo)
LÍQUIDO	<b>Espuma</b> (cerveza, nata montada, <i>mousse</i> ) 	<b>Emulsión</b> (Leche, mayonesa, cremas, salsas) 	<b>Sol</b> (Vino, pinturas, tinta) 	
SÓLIDO	<b>Espuma sólida</b> (pan, merengue) 	<b>Gel</b> (Gelatina, queso) 	<b>Sol sólido</b> (porcelana) 	

Investigación multidisciplinar tanto básica como aplicada en *Ciencia de Coloides e Interfases* con estrecha y dilatada colaboración con la industria

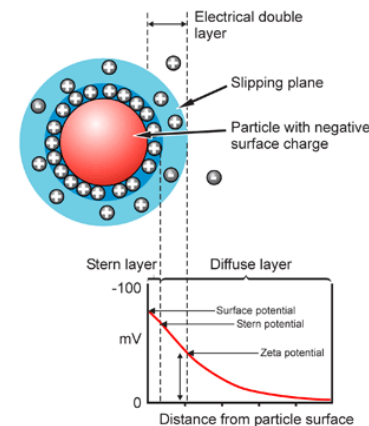
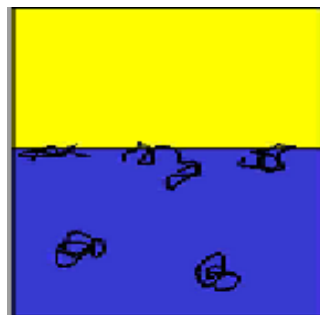
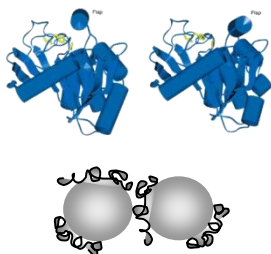
## Interfases

**Área superficial:** característica fundamental en pequeñas partículas.

Gran relación área/volumen: importancia en interacción con otros sistemas.



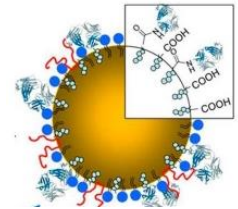
Length of side of cube	Total surface area in sample
1.0 cm	6 cm <sup>2</sup>
1.0 μm	6 m <sup>2</sup>
1.0 nm	6000 m <sup>2</sup>



# Líneas de investigación:

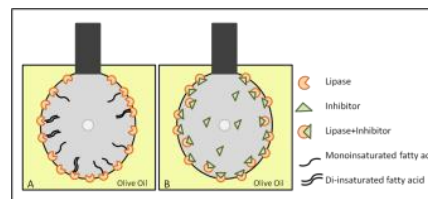
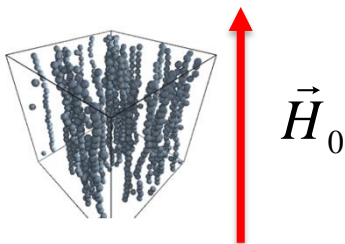
## COLOIDES:

- Nanopartículas para transporte de fármacos, proteínas y material genético.
- Emulsiones alimentarias.
- Suspensiones magnetorreológicas.
- Nanogeles.
- Estudios teóricos y de simulación: teoría del Gradiente, dinámica Browniana, técnicas Montecarlo, dinámica rotacional estocástica.
- Estabilidad coloidal de fluidos complejos. Cinética de agregación de coloides poliméricos modelo.



## INTERFASES:

- Físico-Química de superficies e interfases. Propiedades interfaciales de monocapas.
- Superficies anti-adherentes superhidrófobas.



# Técnicas:

## Infraestructura e instrumentación comercial y diseñada ad hoc:

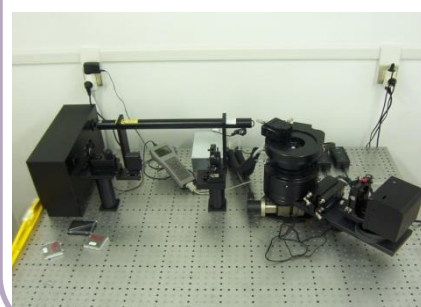
Rheology



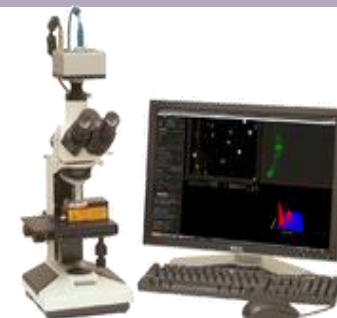
Hydrodynamic diameter  
Electrophoretic mobility



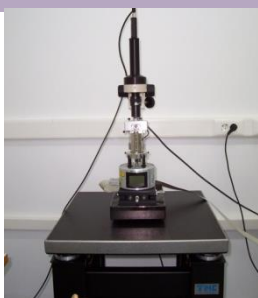
3D-Dynamic and Static  
Light Scattering



Hydrodynamic diameter  
(NTA)



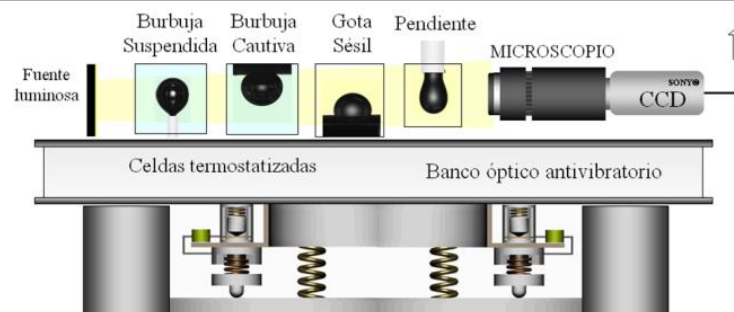
AFM



Langmuir Film Balance



Surface tension.  
Interfacial rheology

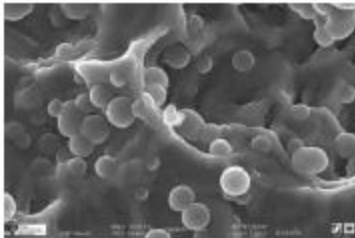
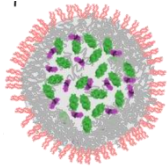




# Sistemas coloidales con aplicación en Nanotecnología y Nanomedicina

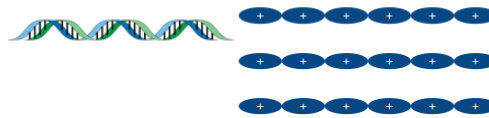
## Nanopartículas de PLGA

Encapsulación biomoléculas hidrofílicas con propiedades terapéuticas



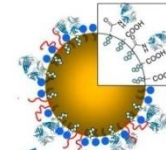
## Poliplejos

Compactación de ADN



## Nanoemulsiones

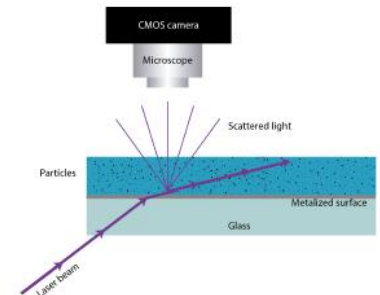
de aceite de oliva para transporte de fármaco hidrofóbico anticancerígeno



## Exosomas

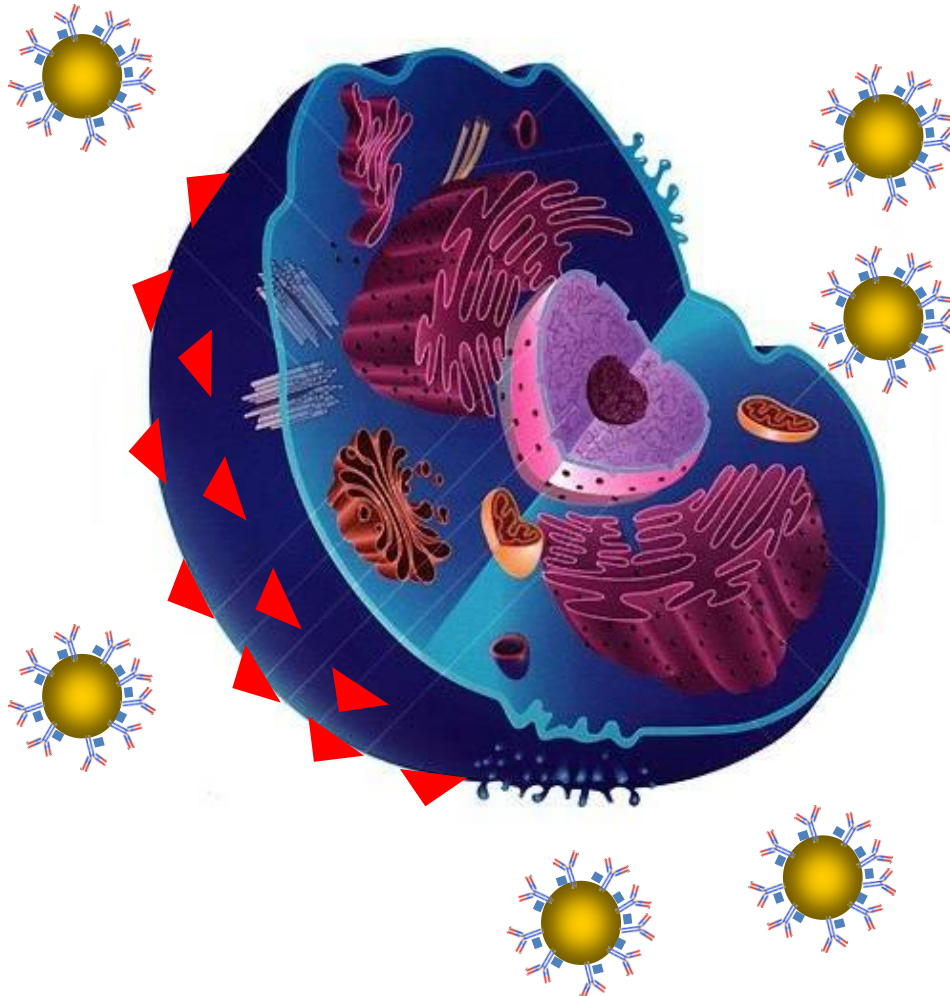


## Nanoparticle Tracking Analysis (NTA)

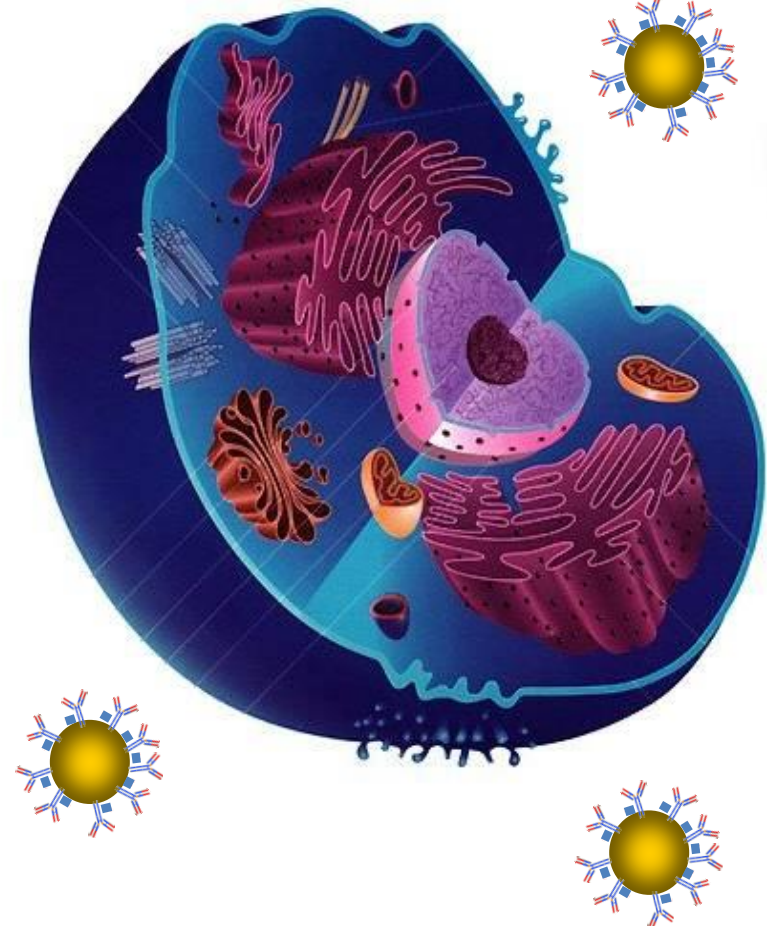


# NANOCÁPSULAS FUNCIONALIZADAS

CÉLULA TUMORAL



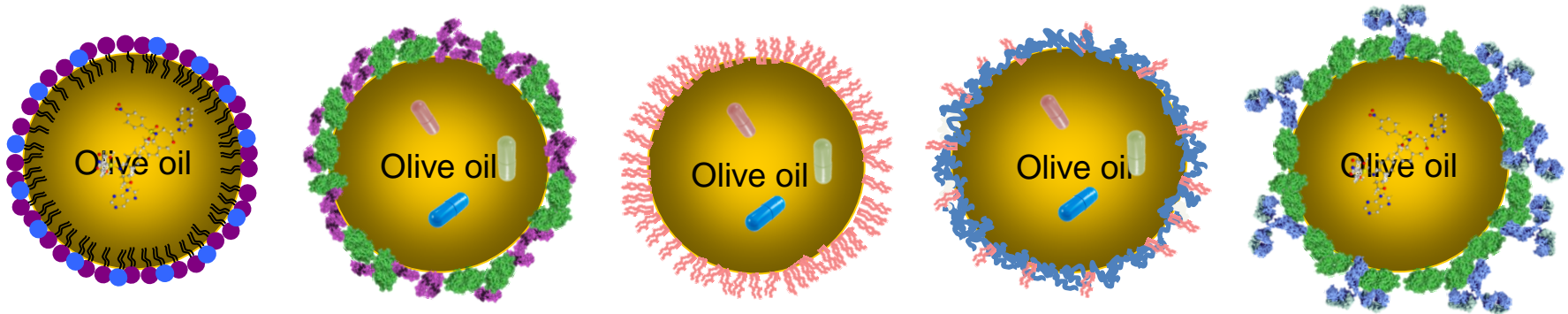
CÉLULA NORMAL



# NANOCÁPSULAS FUNCIONALIZADAS

SMART OLIVE-OIL NANOCAPSULES FOR ORAL DELIVERY OF DRUGS AGAINST  
PANCREATIC CANCER STEM CELLS (STEMNANOMAT)

Proyecto MAT2015-63644-C2-1-R



OTG MEGA-10



HSA Lectins



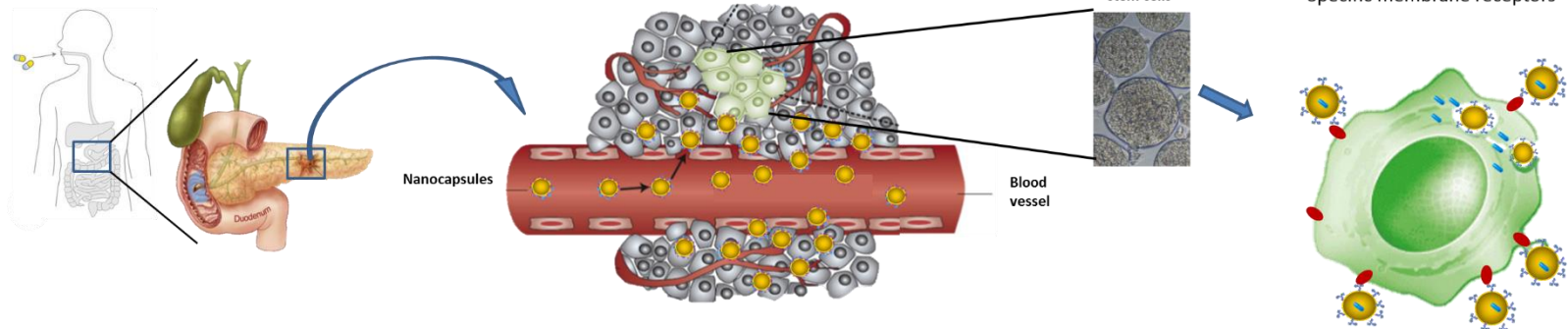
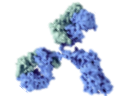
Hyaluronic acid



Chitosan



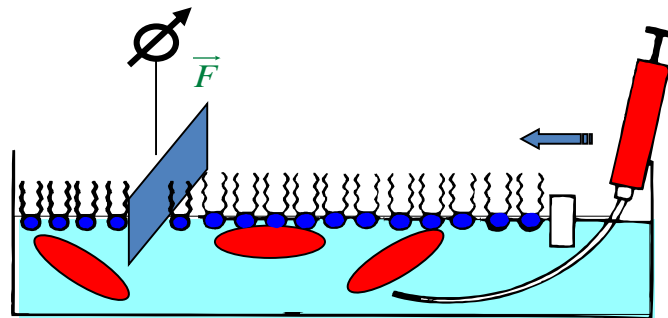
Antibody



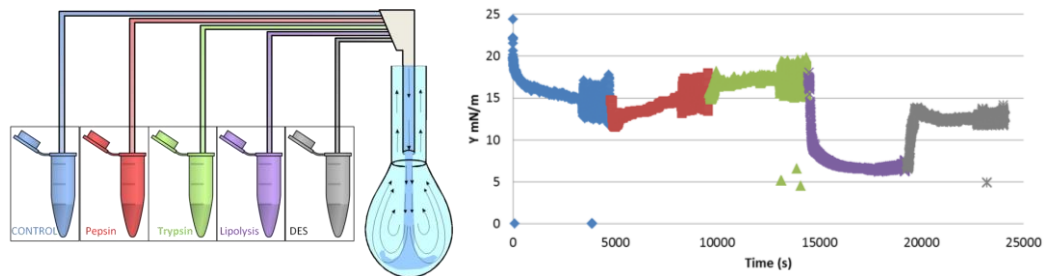


# SMART OLIVE-OIL NANOCAPSULES FOR ORAL DELIVERY OF DRUGS AGAINST PANCREATIC CANCER STEM CELLS (STEMNANOMAT)

## DRUG-MEMBRANE INTERACTIONS



## INTERFACIAL BEHAVIOR: DIGESTION PHENOMENON

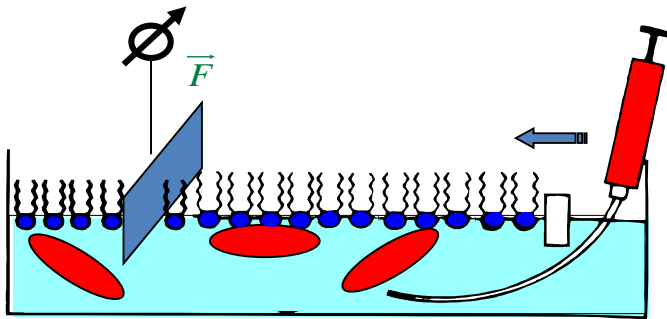


## UPTAKE CANCER CELLS

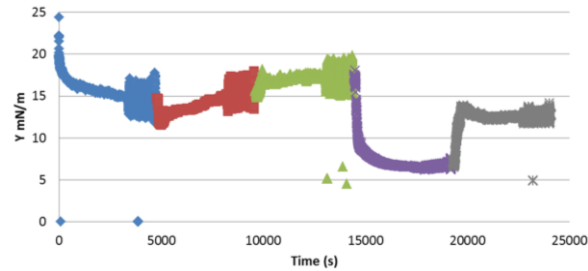
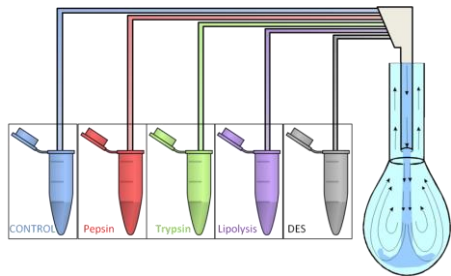
# SMART OLIVE-OIL NANOCAPSULES FOR ORAL DELIVERY OF DRUGS AGAINST PANCREATIC CANCER STEM CELLS (STEMNANOMAT)

## MAT2015-63644-C2-1-R

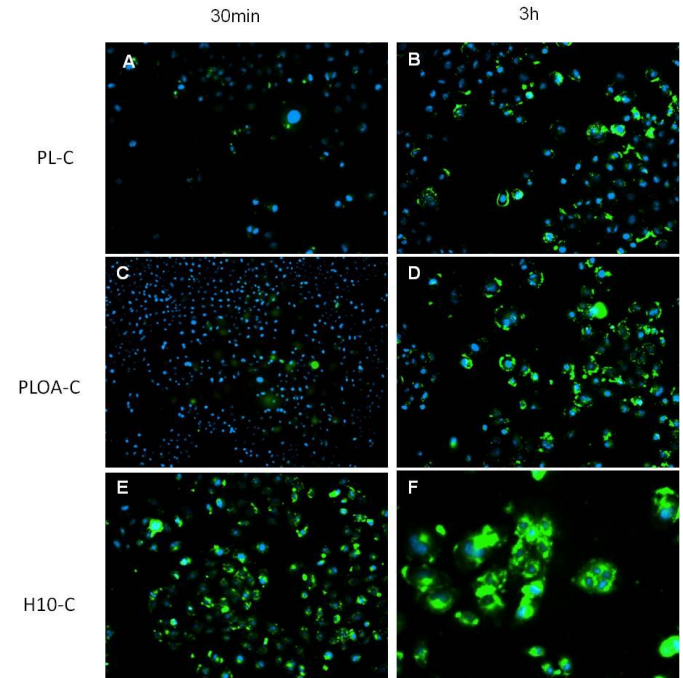
### DRUG-MEMBRANE INTERACTIONS



### INTERFACIAL BEHAVIOR: DIGESTION PHENOMENON



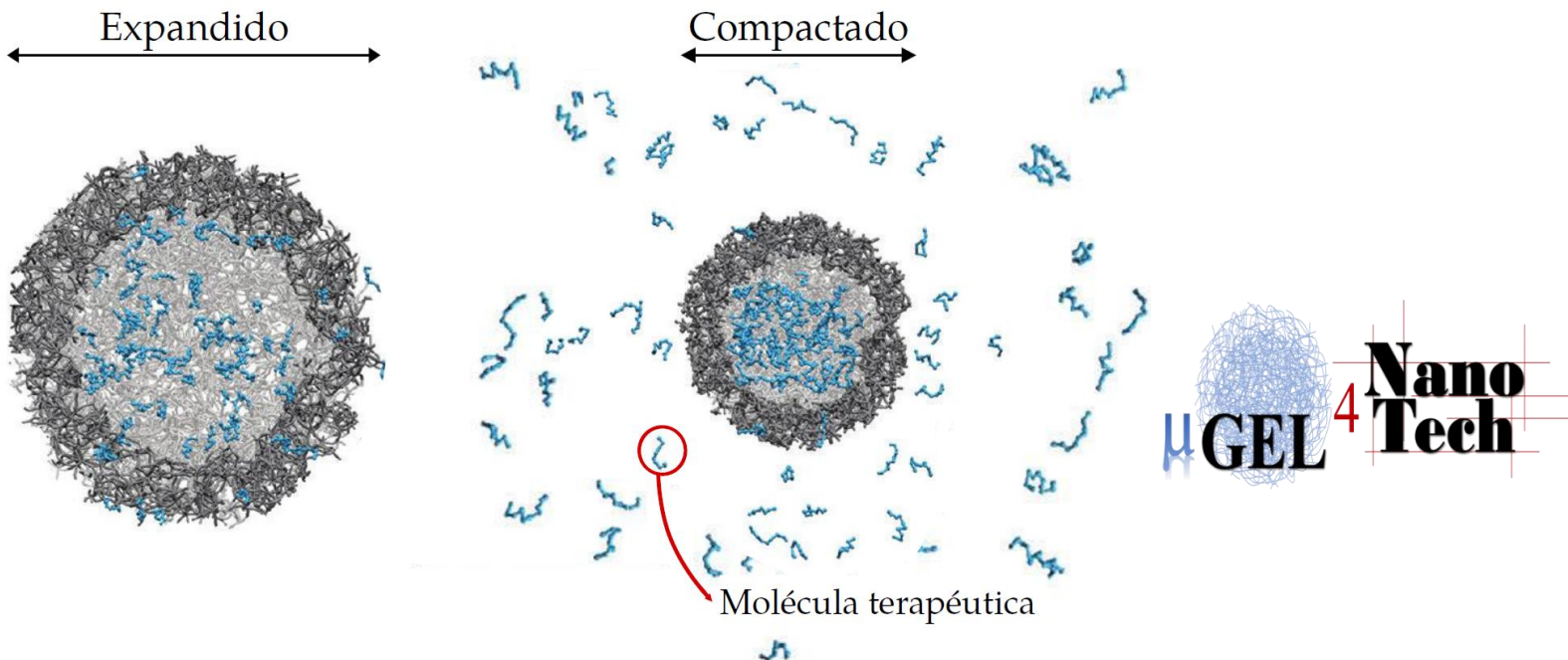
### CANCER CELL UPTAKE

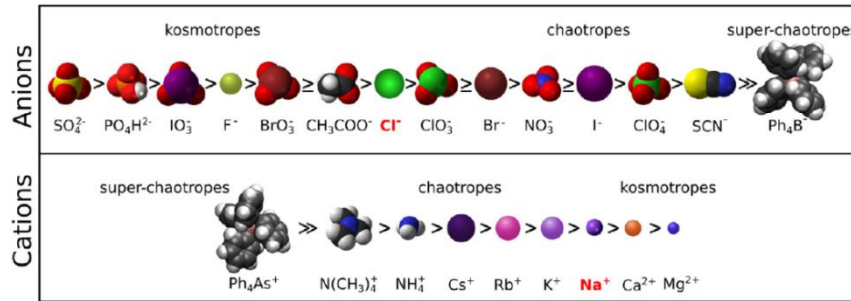


# Interacciones y propiedades colectivas de sistemas de materia blanda basados en microgeles de interés en nanotecnología.

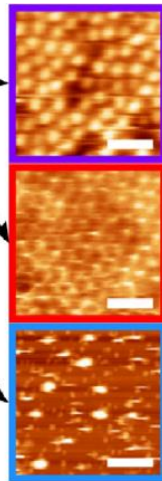
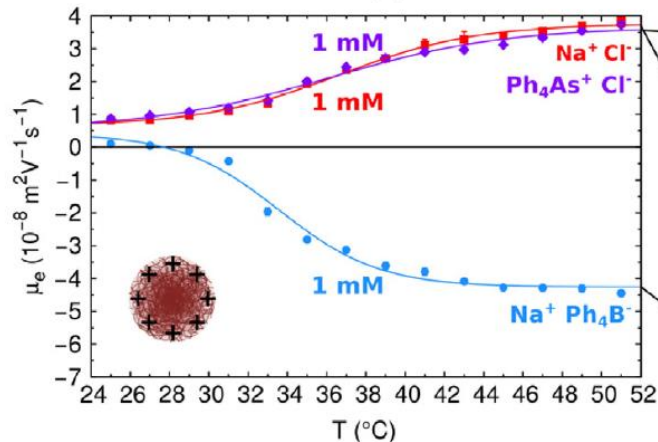
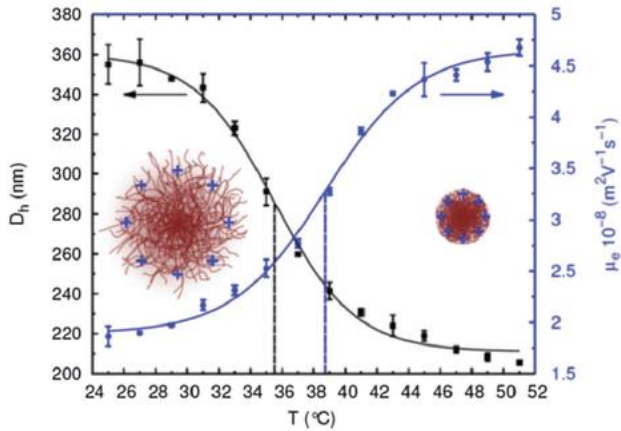
## Proyecto FIS2016-80086-C2-1-P

**TEORÍA, SIMULACIONES Y EXPERIMENTOS DE SISTEMAS FORMADOS POR MICROGELES CARGADOS SENSIBLES A LA TEMPERATURA** (interacciones, propiedades Físico-Estadísticas, estructura microscópica, adsorción de biomoléculas, material genético, estudio de las propiedades físicas y de sus implicaciones en aplicaciones Biomédicas)

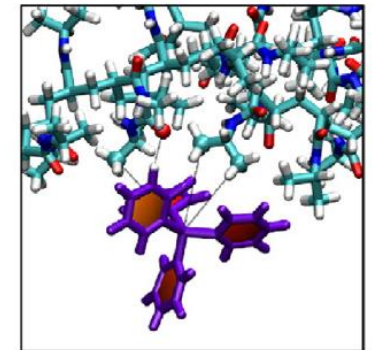
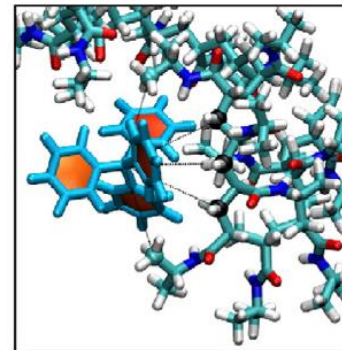
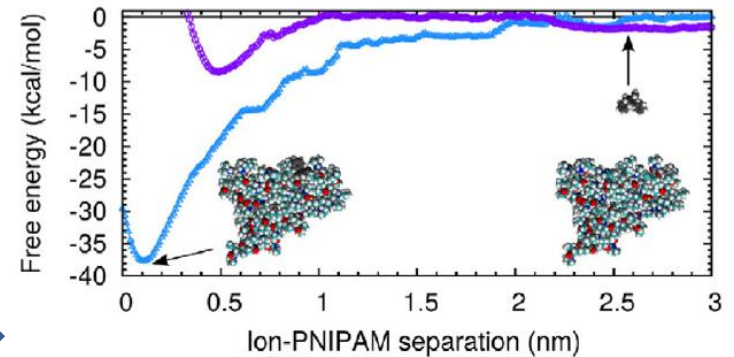




## Experimental Results



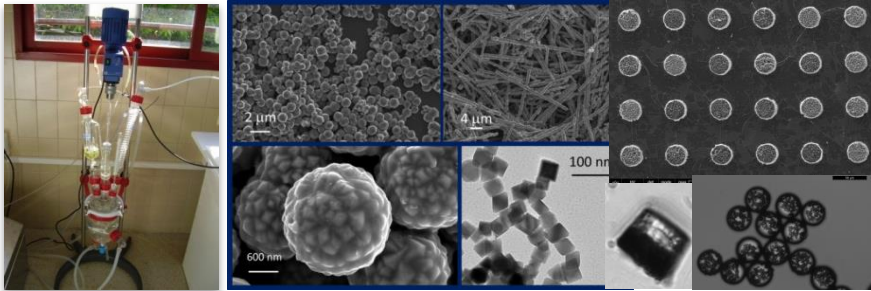
## Molecular Dynamic Simulations Results



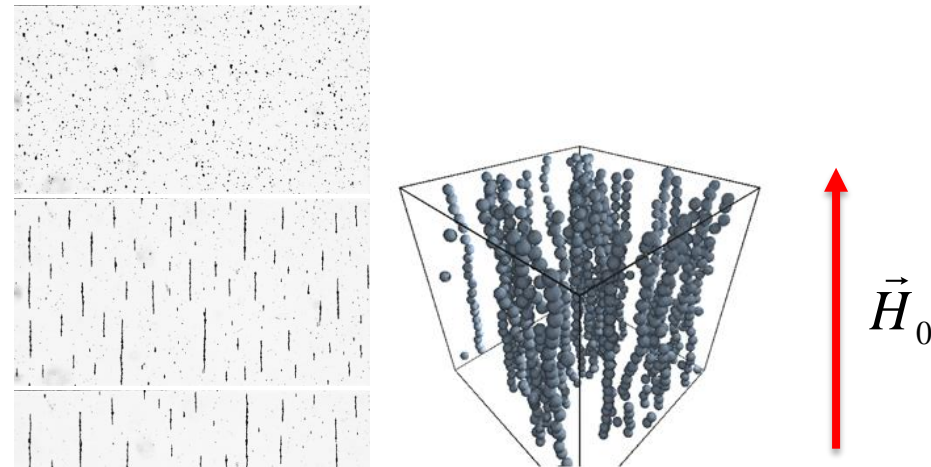


# FLUIDOS NO-NEWTONIANOS - REOLOGÍA - COLOIDES MAGNÉTICOS

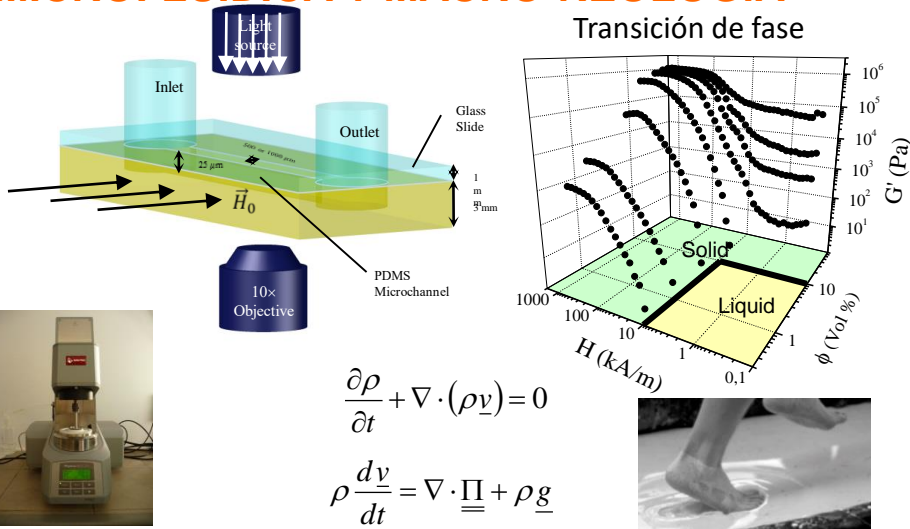
## FABRICACIÓN DE NANOPARTÍCULAS



## SIMULACIONES Y TEORÍA



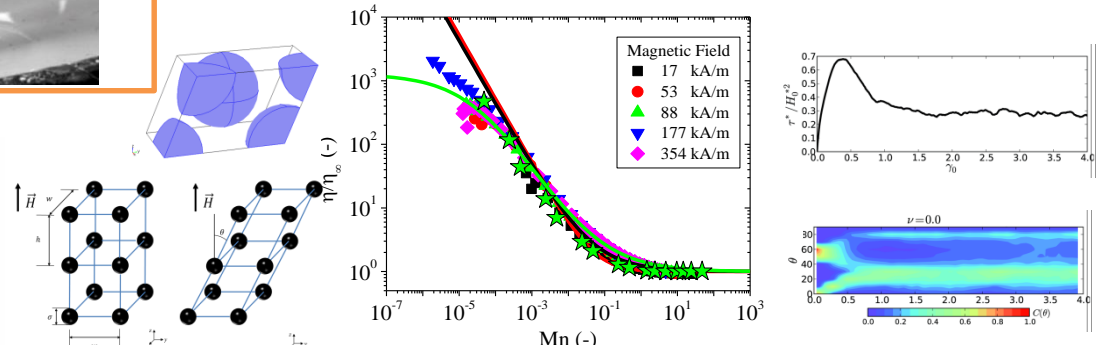
## MICROFLUIDICA Y MACRO-REOLOGÍA



## Comparación: experimentos – teoría - simulaciones

- Reometría
  - Modelado estructural
  - Simulación dinámica molecular
- $$M_i \frac{d^2 \vec{r}_i(t)}{dt^2} = -\zeta_i \left( \frac{d\vec{r}_i(t)}{dt} - \vec{u}_i^\infty \right) + \vec{F}_i + \vec{f}_B(t)$$

## APLICACIONES...

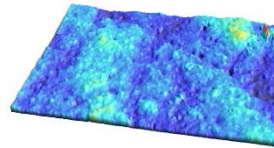




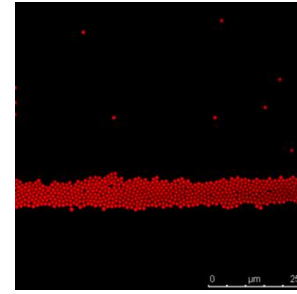


Nonsticky coatings, anti-icing surfaces, biomimetic bone-like coatings, colloidal assembly

## Topography

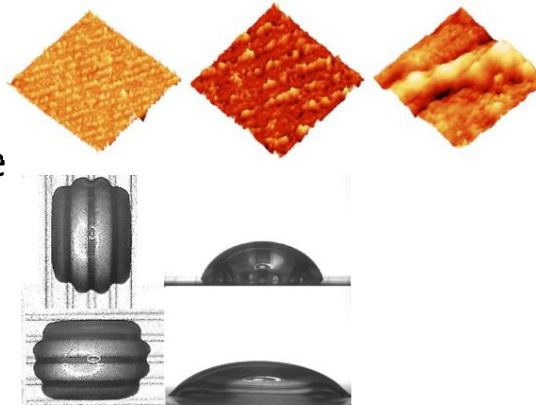


Atomic Force Microscope  
White Light Confocal Microscope



## Surface tailoring

RF Plasma Discharge Device  
Direct Laser Patterning  
Chemical functionalization  
UV/Ozone

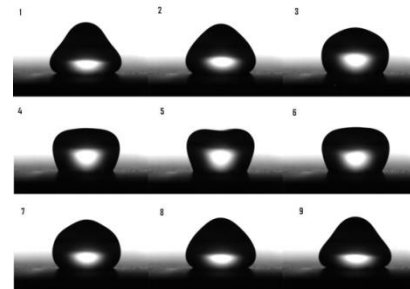
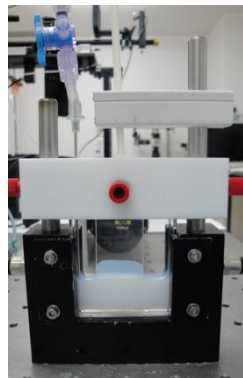
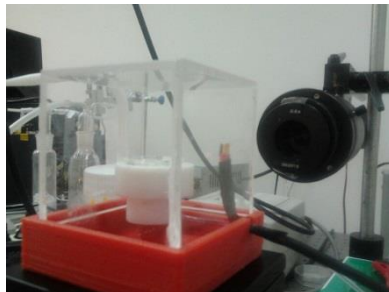


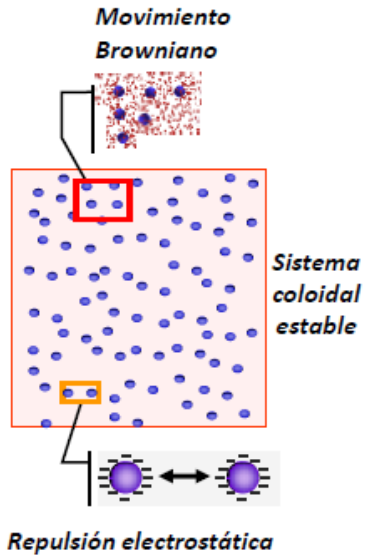
## Wettability



Sessile Drop/Captive Bubble  
Tilted Drop  
Magnetic Drop (high speed camera)  
Vibrating Drop (high speed camera)  
Bouncing Drop (high speed camera)  
Drop image analysis

## Prototyping





## Fenómeno de agregación

(Proceso de formación de estructuras)

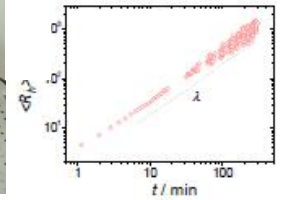
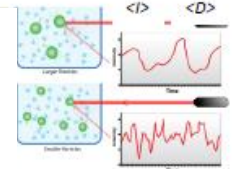
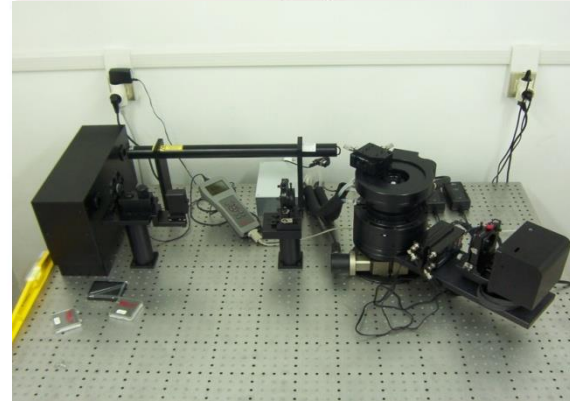
+ Electrolito



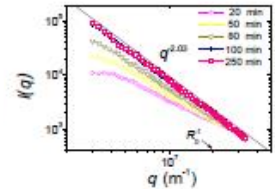
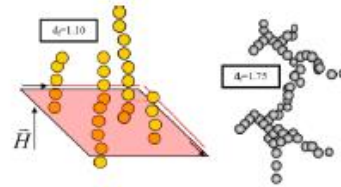
+ Macromoléculas adsorbidas



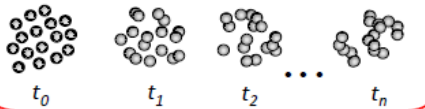
## Dispersión de Luz



## Formación de estructuras dinámicas



## Formación de estructuras dinámicas

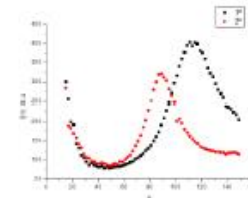
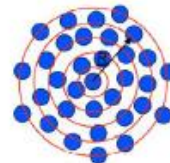


Estructura de los agregados

Cinética de agregación

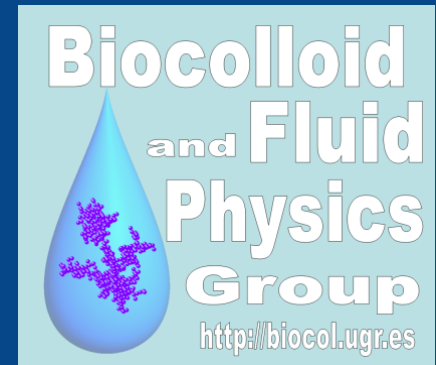
Interacciones  
macromolécula-partícula y  
macromolécula-macromolécula

## Formación de estructuras estáticas



Grupo de investigación FQM-115:

*Física de Fluidos y Biocoloides*



Más información:

<http://biocol.ugr.es>

*Gracias por vuestra atención*