Journées J3N Nationales en Nanosciences et en Nanotechnologies

# EVALON

## Evaluation in situ of the Interfacial Affinity of Organic Ligands and Nanoparticles in Suspension


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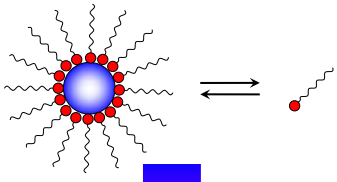
## Dynamic Systems



Equilibrium allows functionalization with ≠ ligands

**Compatibility with the medium**

## Gaining Insight into the Interactions

**Measurement of the affinity**

Particles – Ligands

**Quantification of the populations**

Free – Bound

As a function of several parameters
Size – Concentration – Crystalline faces – Composition

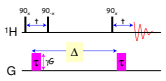
**Determination of the ADSORPTION ISOTHERM**

## Pulsed Field Gradient Spin Echo NMR Spectroscopy (PGSE NMR)

### Determination of the Diffusion Coefficient

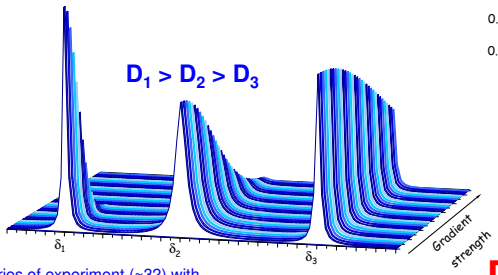
- ✓ *For every spin ½ nucleus*
- ✓ *D from 10 ms to 2 s*
- ✓ *$r_H$ from a few Å to tens of ns*

Stimulated echo

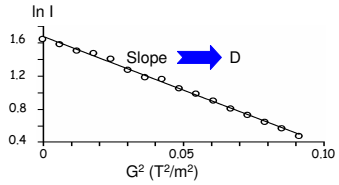


$\ln(I/I_0) = -(\gamma\tau G)^2(\Delta-\tau/3)D$

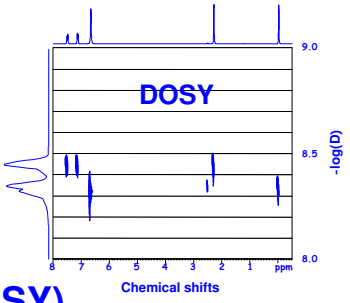
Gradient strength: G
Diffusion delay: Δ
Gradient pulse length: τ
Diffusion coefficient: $D = kT/6\pi\eta r_H$




A series of experiment (~32) with constant difusion delay (Δ) and increasing gradient strength




Differentiation in frequency and diffusion domain




**Diffusion Ordered SpectroscopY (DOSY)**

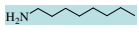
## Investigated Systems

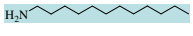
### Study of the interaction NPs vs Ligands

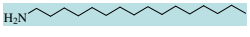
NPs : Metals (Au) – Metal Oxides (ZnO) – II-VI Semiconductors (CdSe)

For example : ZnO NPs synthesis using different Ligands

$[ZnCy_2] + H_2O \xrightarrow[\text{r.t.}]{\text{Solvent, x L}} ZnO.x\,L +$ 



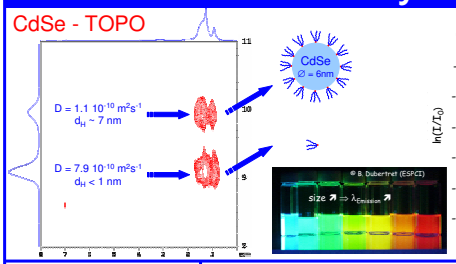



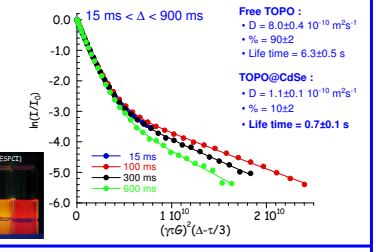
Miguel Monge et al, *Angew. Chem. (Int. Ed. Engl.)* 2003, *42*, 5321.
French Patent CNRS, Fr 03-042825, 2003, PCT/FR/04/00850, 06 Avril 2004

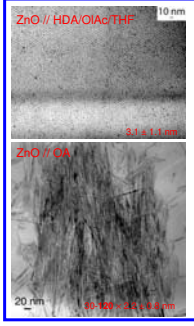

Requirements : High levels of purity, crystallinity and monodispersity

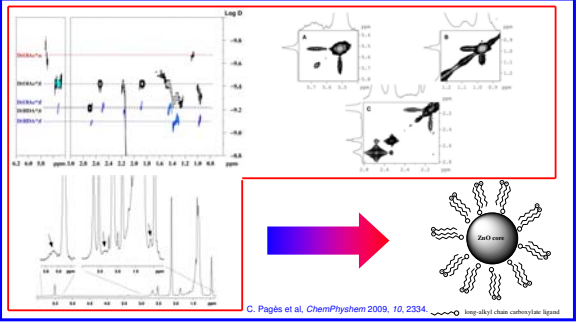
## Preliminary Results

CdSe - TOPO



C. Pagès et al, *ChemPhyshem* 2009, *10*, 2334.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