

Interactions between cerium and iron oxide sub-10 nm nanoparticles with 3T3 fibroblasts : role of the coating

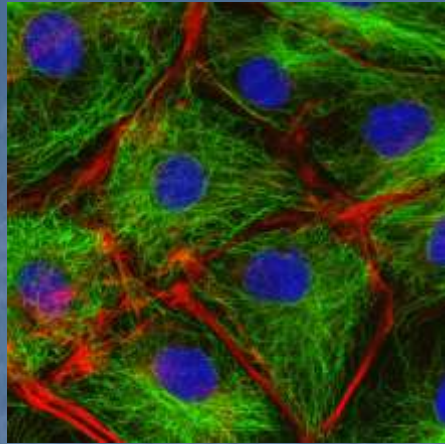
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New physics building
Université Paris 7

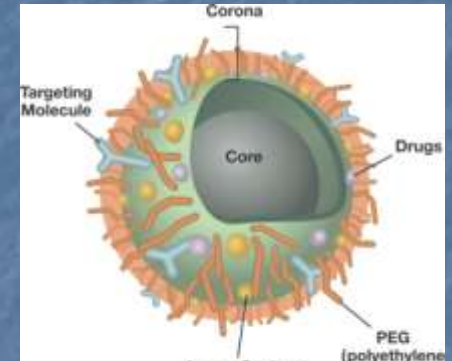


Nanoparticles : Applications

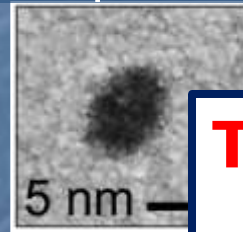


Interactions with living cells

Biomedecine (MRI, Drug delivery, Hyperthermia...)



Nanoparticles



The impact and toxic effect of the NPs on the living cells and consequently on the human?

Catalyse (TiO_2):
Lighting, construction, etc.

Sunscreen (TiO_2 , ZnO),
cosmetics:



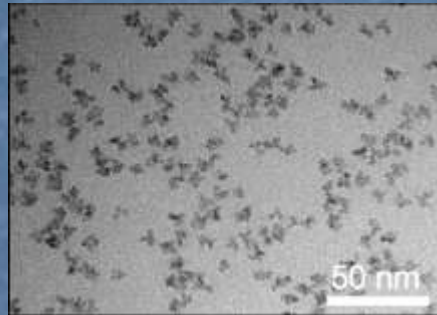
- NPs for Environmental remediation
 - Pollution reduction of diesel (CeO_2), Soot emission reduced by 99 %
 - Reduction of air pollution (TiO_2)
- Paints
- NPs in Pneumatic automobile tyre .

Nanoparticles and NIH/3T3 : Characteristics

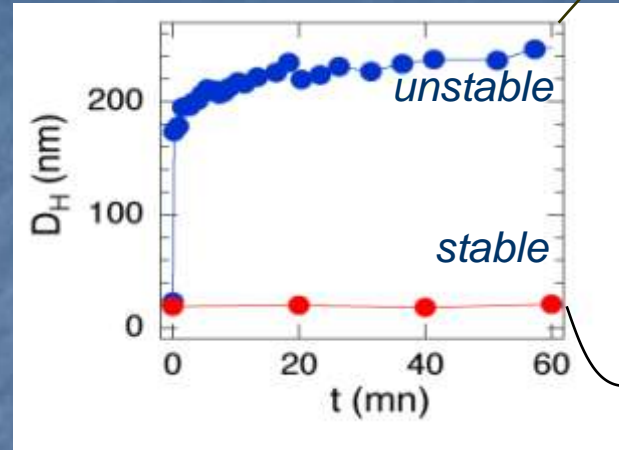
Cerium Oxide



- Diameter 7 nm
- Positely charged
- Faceted
- For coating applications
- Origin : Rhodia France



NPs in culture medium



citrate coating

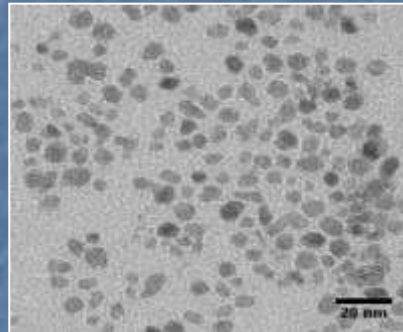


PAA coating

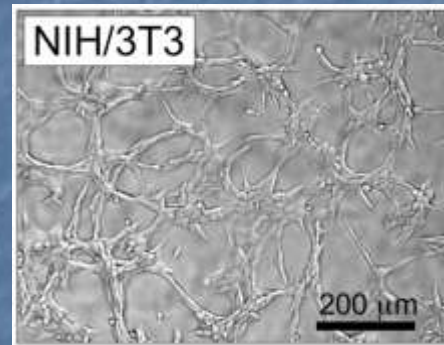
Iron Oxide



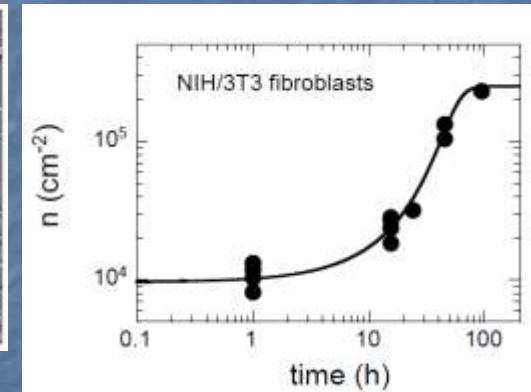
- Diameter 6 nm
- Superparamagnetic
- For biomedical applications
- Origin : Olivier Sandre, University Paris 6



NIH/3T3 Fibroblasts



NIH/3T3 observed by optical microscopy at a 50% confluence (objective 10X).

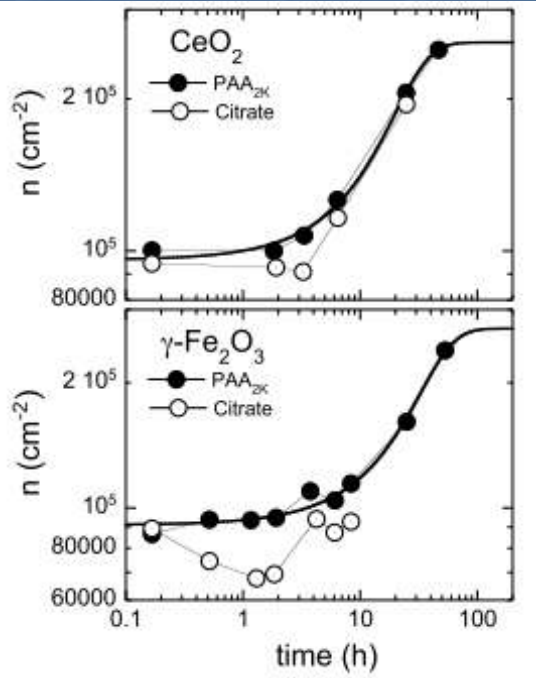


Cellular growth of NIH/3T3. $\tau_D = 12.5$ h

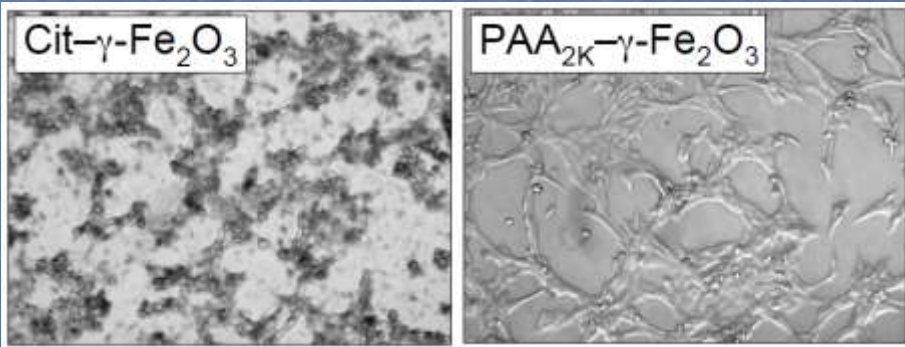


Results

Cellular growth

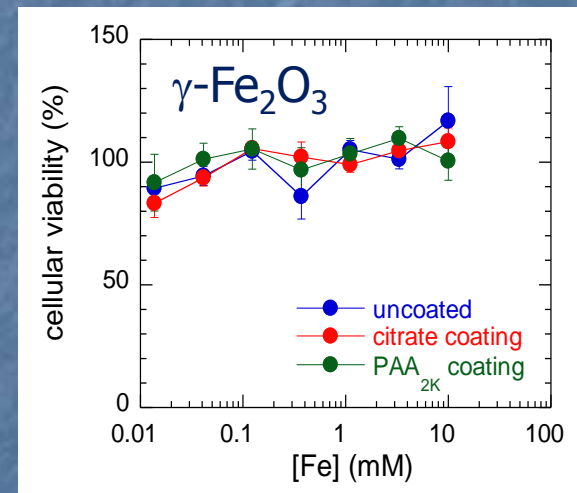
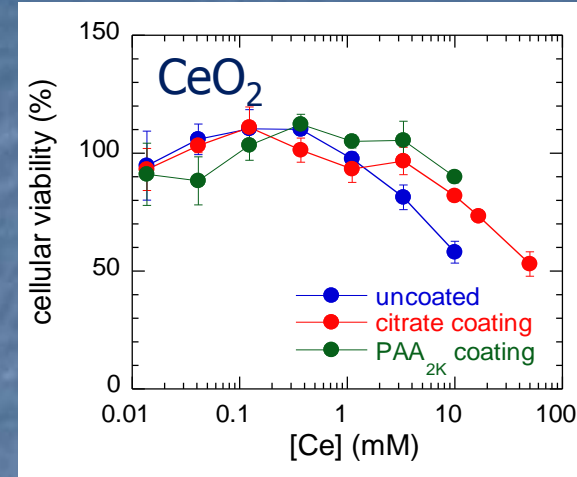


The PAA_{2K}-coated NPs did not affect the cell proliferation over the 48h lasted the experiments. When the cells were exposed to Citrate-coated NPs, the population of adherent fibroblasts started first to decrease by 10% for Cit-CeO₂ and by 30% for Cit-Fe₂O₃ before rising again.



Photos display NIH/3T3 fibroblasts that were exposed during 24h to nanoparticles at a concentration $\{[\text{Ce}], [\text{Fe}]\} = 1 \text{ mM}$.

MTT assay

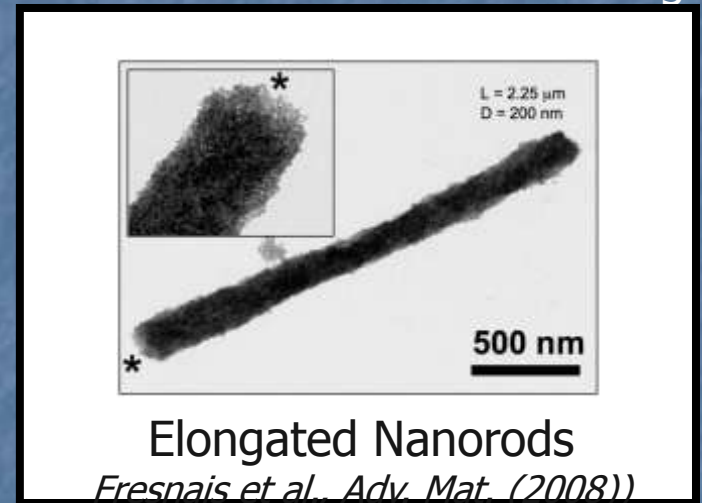
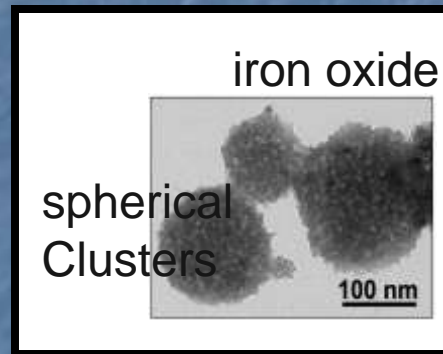


After 24h of exposure to uncoated/coated NPs, cells remained 100% viable relative to controls. Only the bare and the citrate-coated nanocerium exhibited a slight decrease of the mitochondrial activity for $[\text{Ce}] > 5 \text{ mM}$ equivalent to 0.8 g.L^{-1} .

Conclusions & Perspectives

Conclusions:

- In terms of toxicity, both bare and coated NPs have been found to be relatively nontoxic even at very high concentrations (10 mM).
- The uptake of nanomaterials was shown to be dependent first on the coating of the NP, the PAA-coating minimizes the uptake in contrast to the Citrate-coating which increase it.



Perspectives:

- Advanced studies: detection of oxydative stress, the pro-inflammatory response and genotoxicity.
- Synthesis of Nanomaterials : therapeutic targeting in biomedecine.