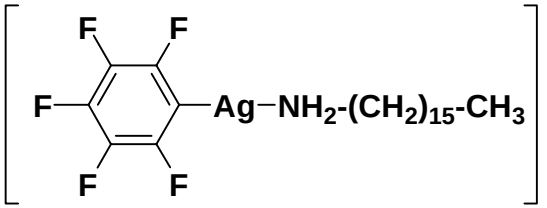
UNIVERSIDAD DE LA RIOJA

SILVER NANOPARTICLES AND GOLD METALLODENDRIMERS: FROM MOLECULAR PRECURSORS TO NANOMATERIALS

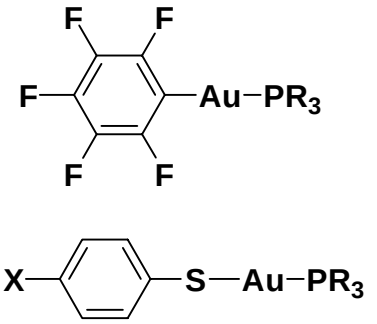
Miguel Monge

nano Spain Conf

GOLD(I) and SILVER(I) COMPLEXES

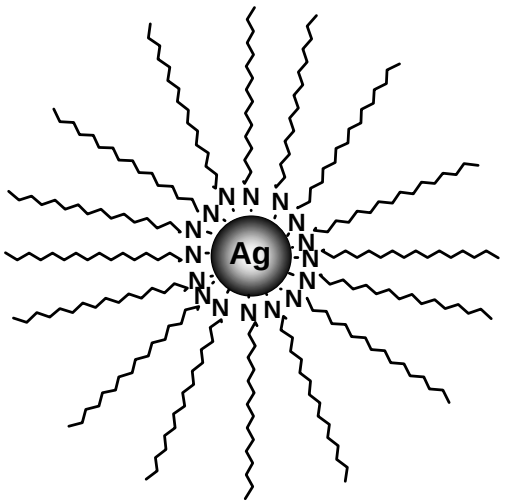


Organometallic precursor

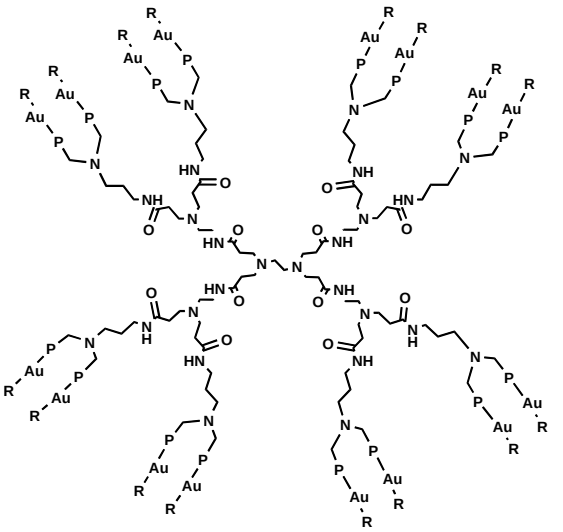


Molecular building blocks

SILVER NANOPARTICLES



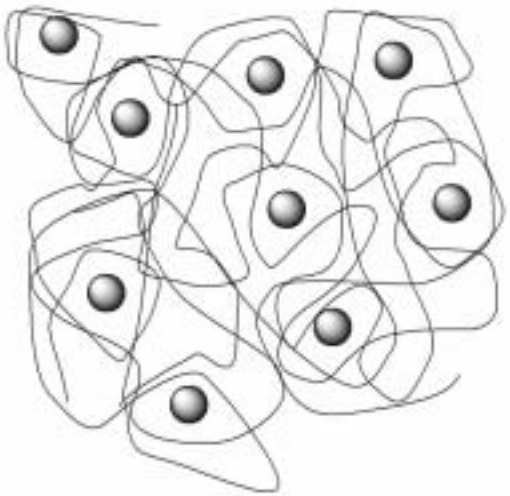
GOLD METALLODENDRIMERS



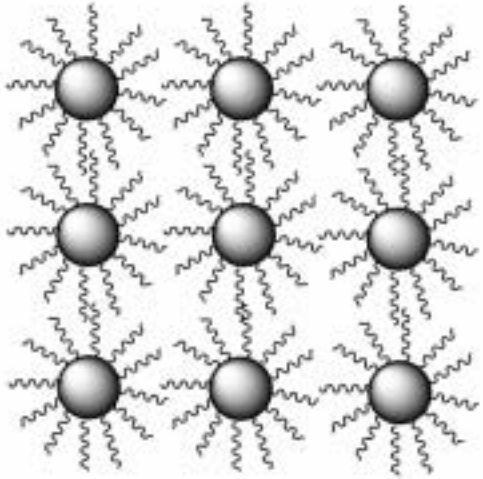
Synthesis of silver nanoparticles from organometallic precursors

ORGANOMETALLIC SILVER COMPOUNDS

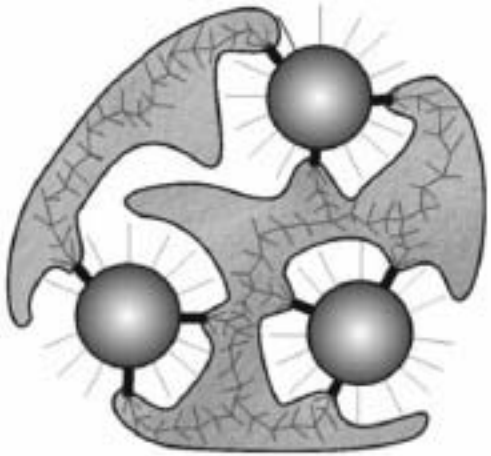
MILD CONDITIONS



POLYMERS



LIGANDS



SiO_2

Silver nanoparticles

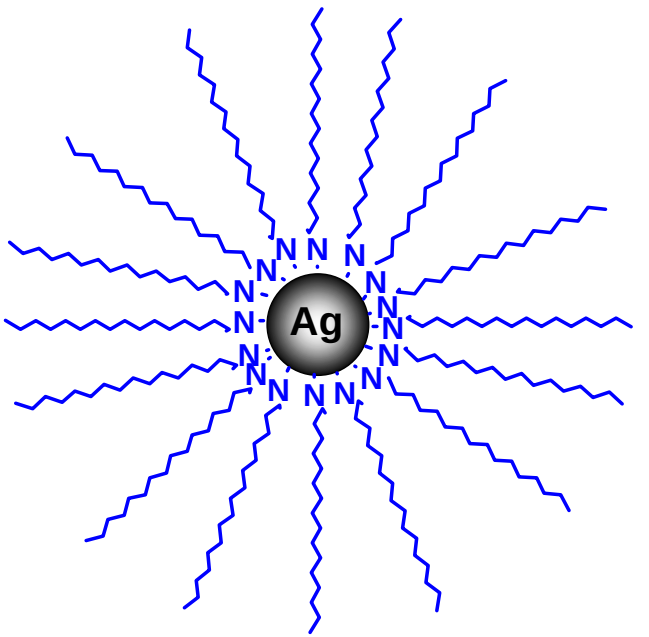
Organometallic precursor synthesis

$$NBu_4[Ag(C_6F_5)_2] + AgClO_4 \xrightarrow[- NBu_4ClO_4]{Et_2O} 2\,[Ag(C_6F_5)]$$

$$[Ag(C_6F_5)] + NH_2\text{-}(CH_2)_n\text{-}CH_3 \xrightarrow{Tolueno} [Ag(C_6F_5)(NH_2\text{-}(CH_2)_n\text{-}CH_3)]$$

Silver nanoparticles synthesis

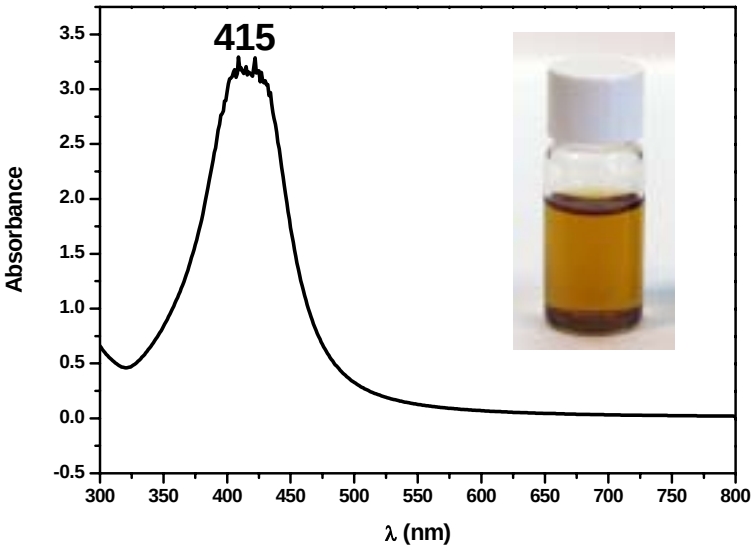
$$[Ag(C_6F_5)(NH_2\text{-}(CH_2)_n\text{-}CH_3)] \xrightarrow[\text{reflux}]{\text{Toluene, 7h}}$$



R = C_6F_5

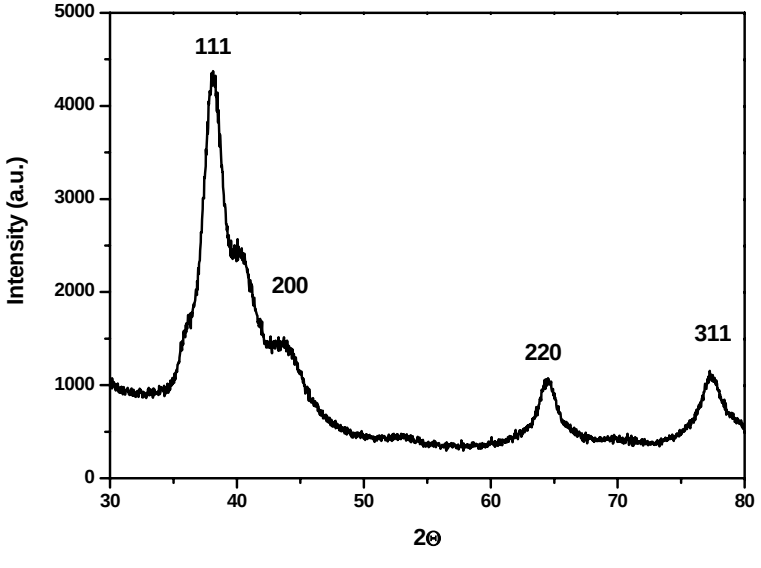
n = 15, 11, 8

Silver nanoparticles



UV-Vis spectrum of Ag NPs in toluene.

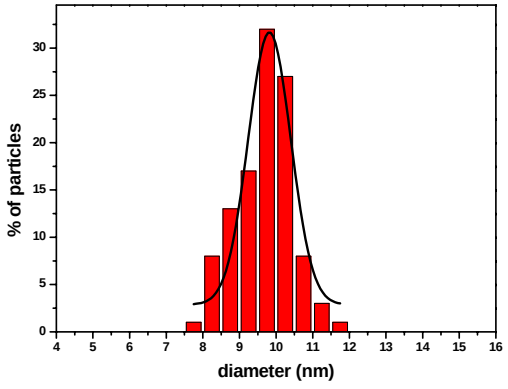
The band at 415 nm is a surface plasmon resonance band. The band energy is related to small and spherical Ag NPs



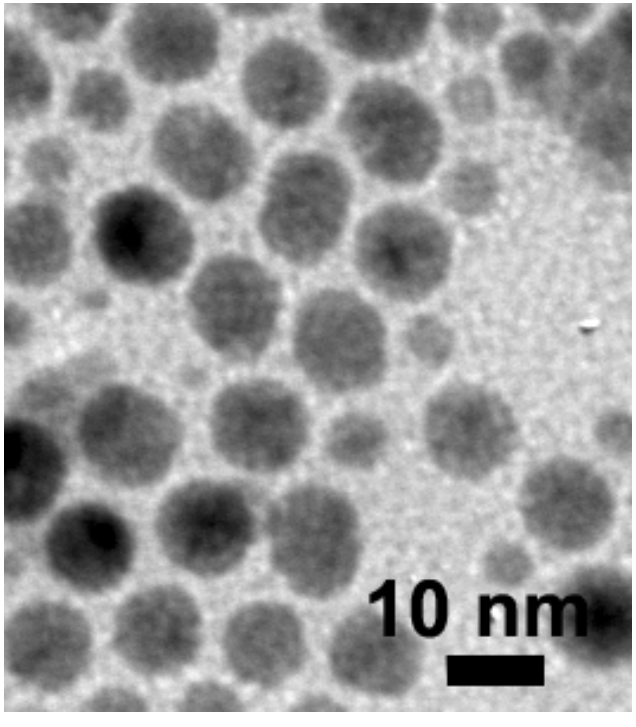
X-ray powder diffraction pattern:

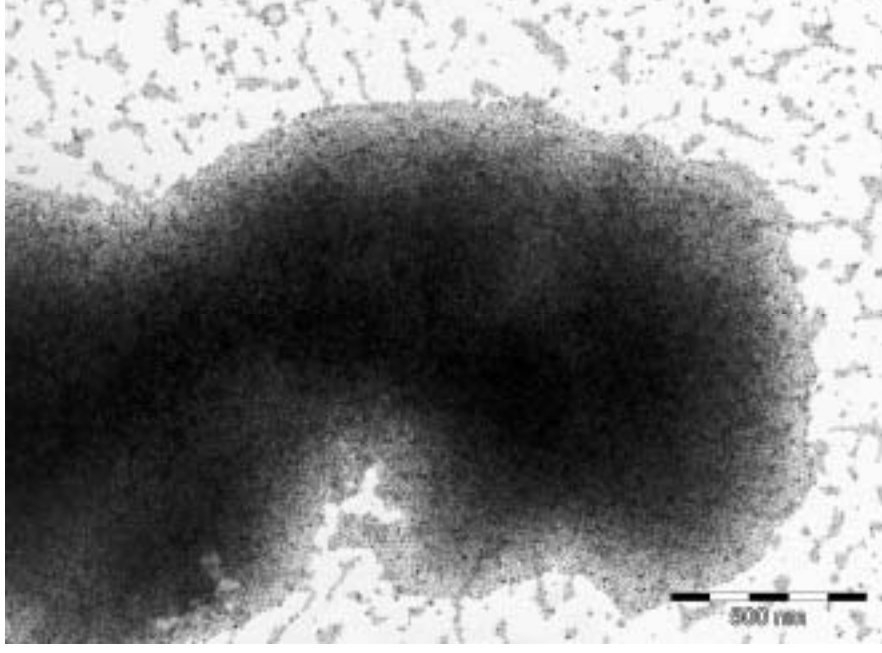
The peaks correspond to the 111, 200, 220 y 311 planes of the metallic silver fcc structure.
Nanoparticle size : 8-10 nm

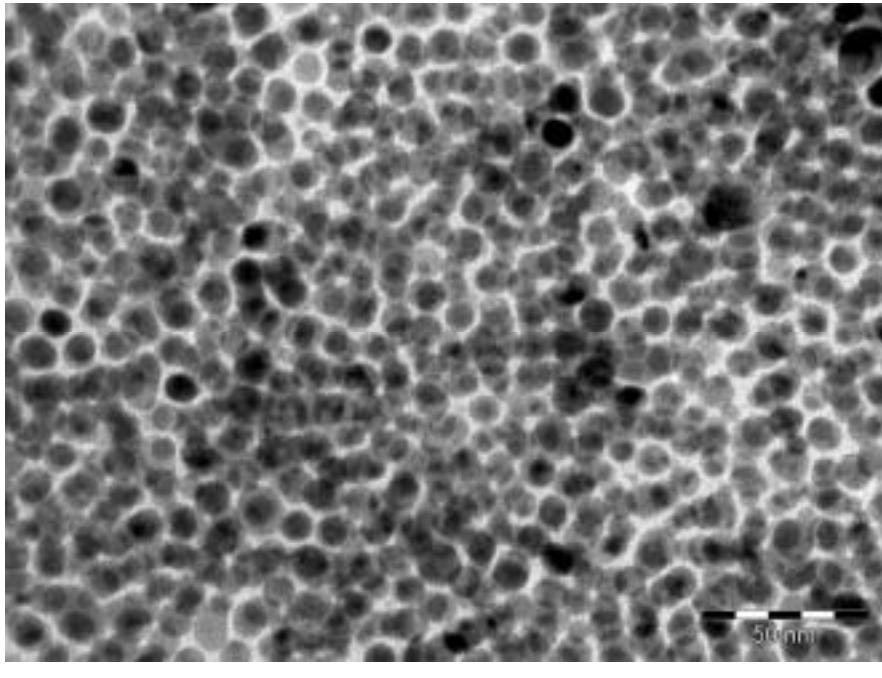
Silver nanoparticles



9.8 ± 1.2 nm



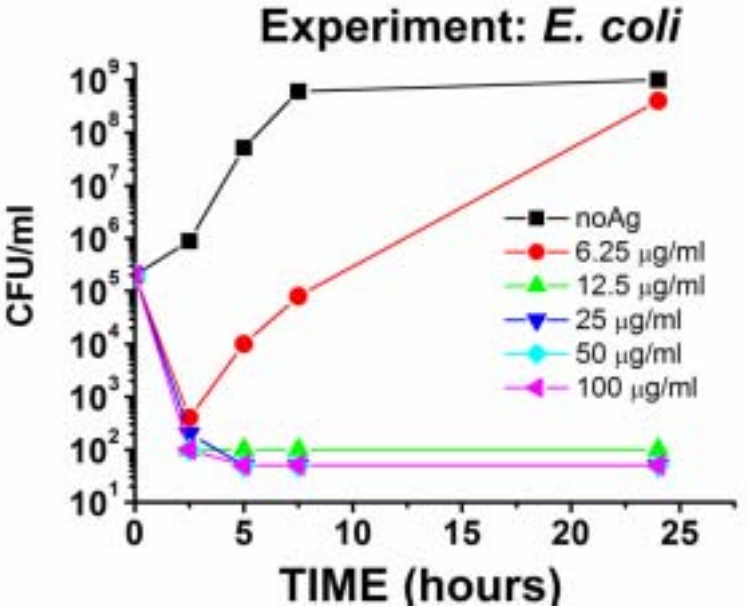


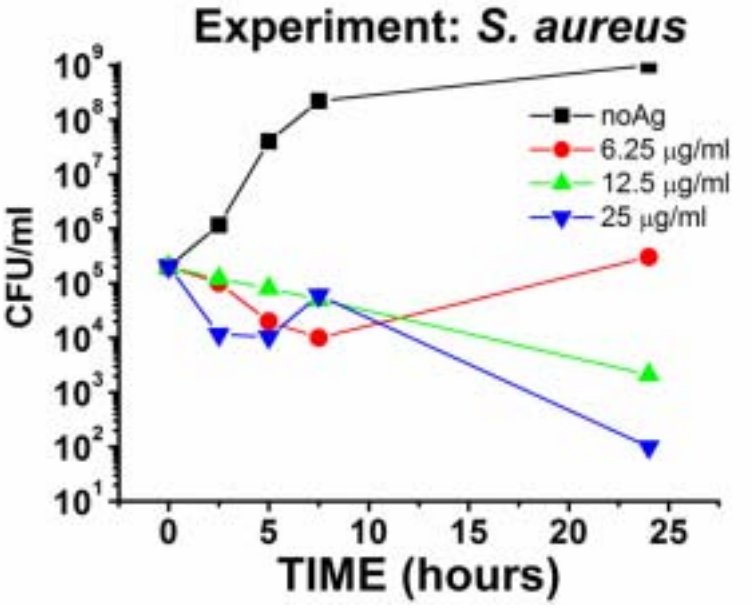


BACTERIOSTATIC AND BACTERICIDAL ACTIVITY OF Ag NPs

Minimal Inhibitory Concentration (MIC) and Minimal Bactericidal Concentration (MBC) of Ag NPs

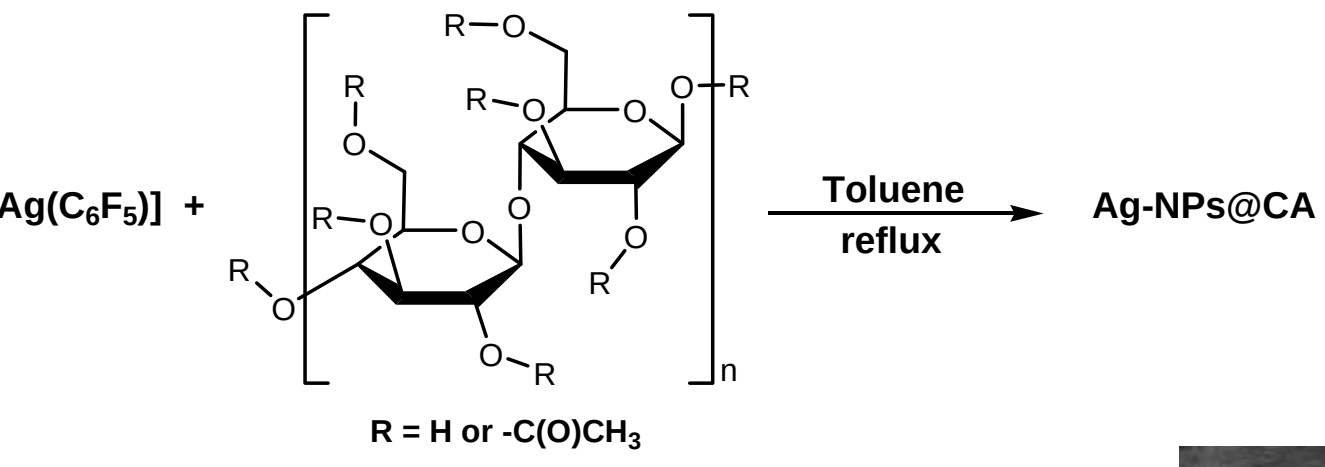
Bacterial Strain	MIC (μg/ml)	MBC (μg/ml)
E. coli ATCC25922	12.5	12.5
S. aureus ATCC25923	12.5	25
L monocytogenes CECT432	25	25



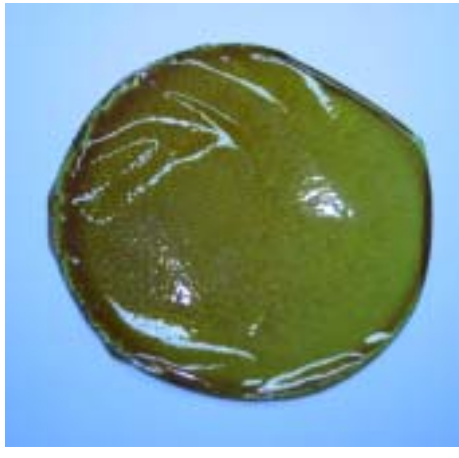


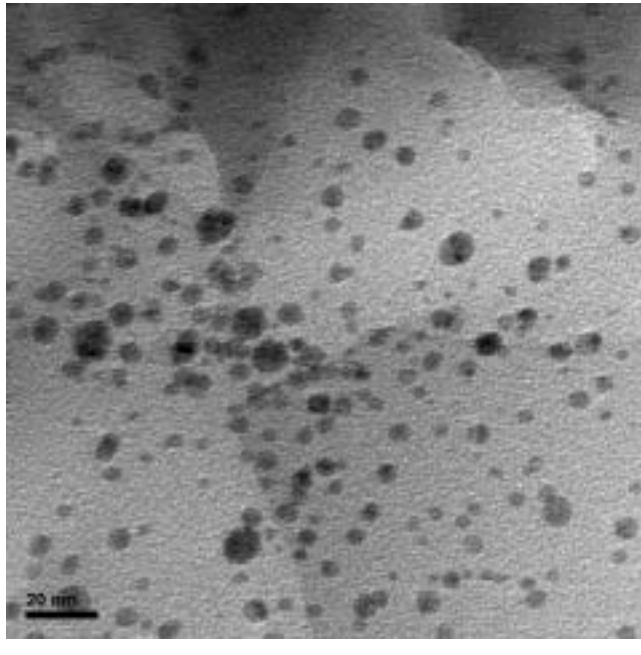
POLYMER STABILIZED SILVER NANOPARTICLES

CELLULOSE ACETATE (CA): textile applications



R = H or -C(O)CH$_3$



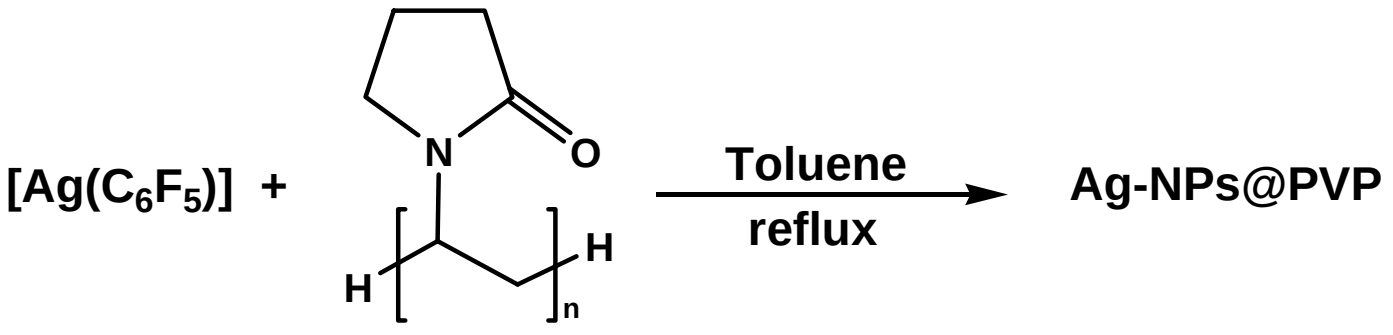


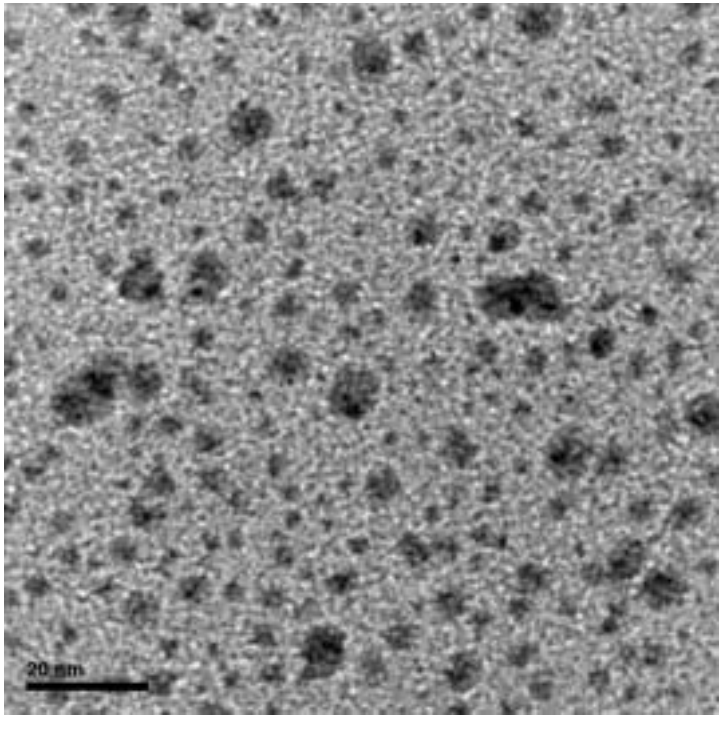
- Small size silver nanoparticles (ca. 5 nm).

- Slow solvent evaporation leads to cellulose acetate films loaded with Ag NPs.

POLYMER STABILIZED SILVER NANOPARTICLES

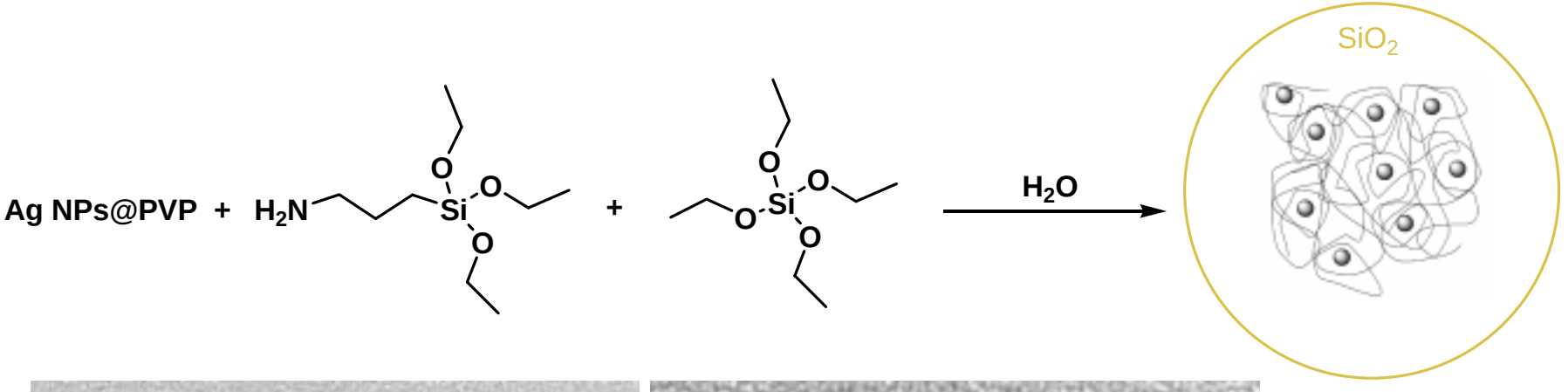
POLIVINILPIRROLIDONE (PVP): water soluble Ag NPs

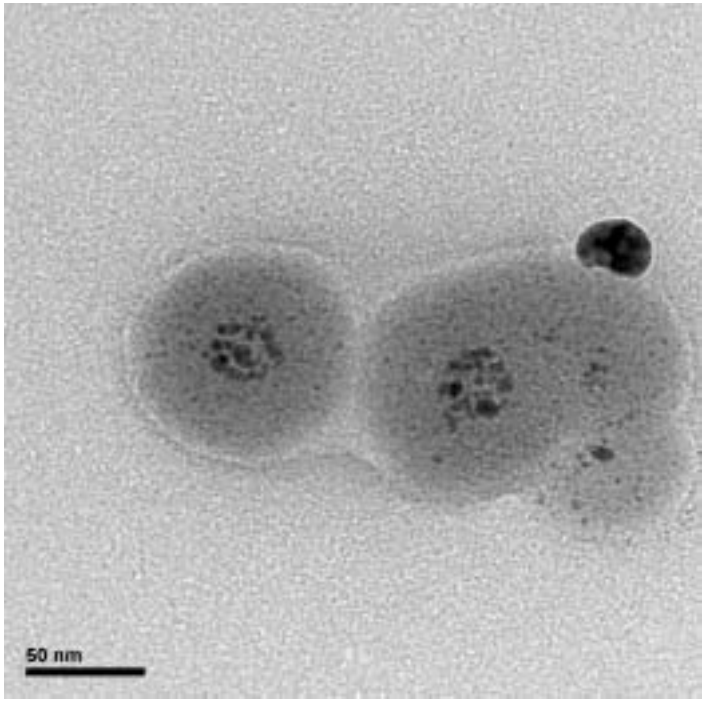


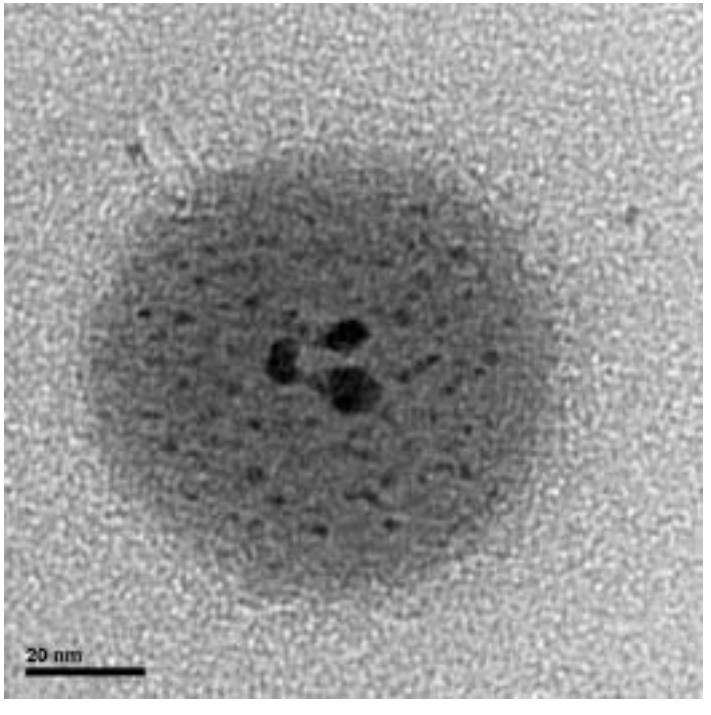


POLYMER STABILIZED SILVER NANOPARTICLES

SILVER NANOPARTICLES STABILIZED WITH NANO-SILICA

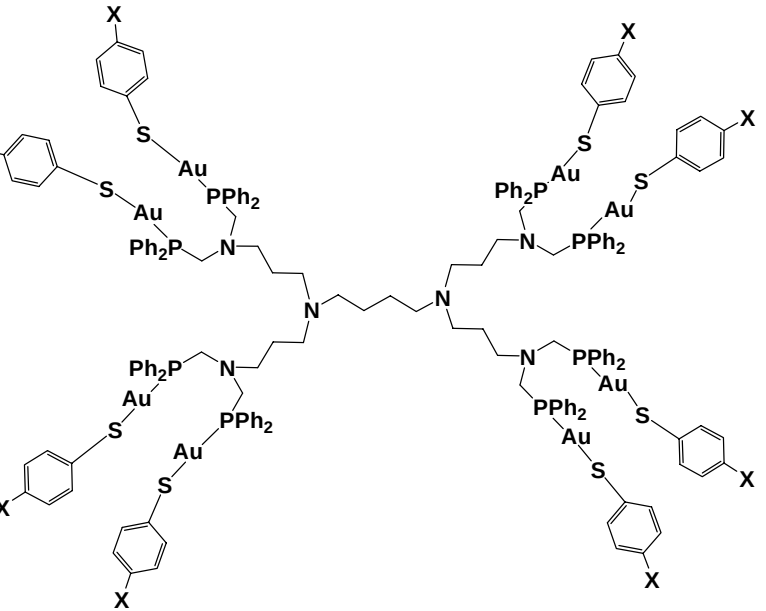




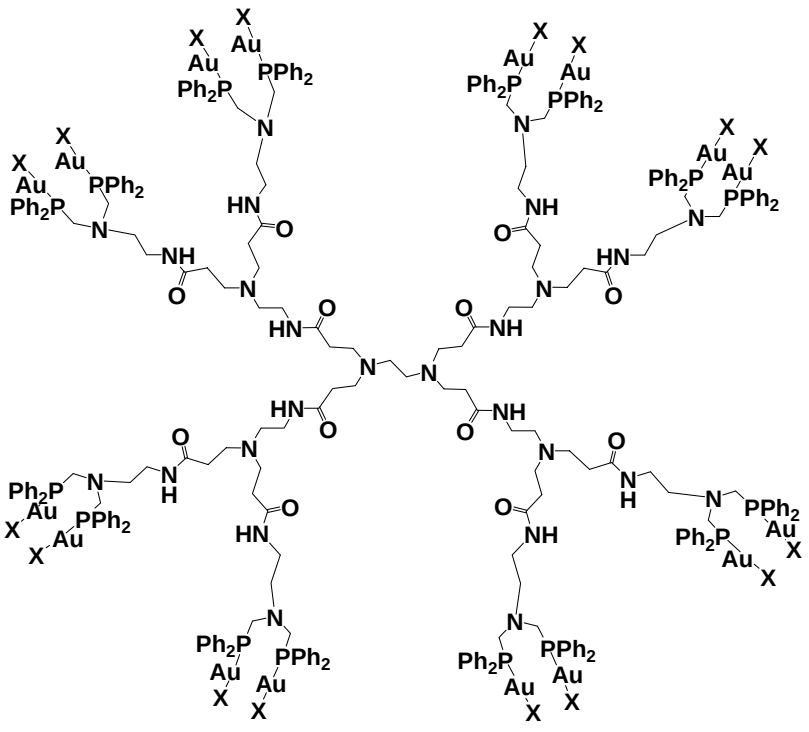


Au(I) Metallodendrimers

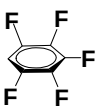
PPh_2-PPI-G1



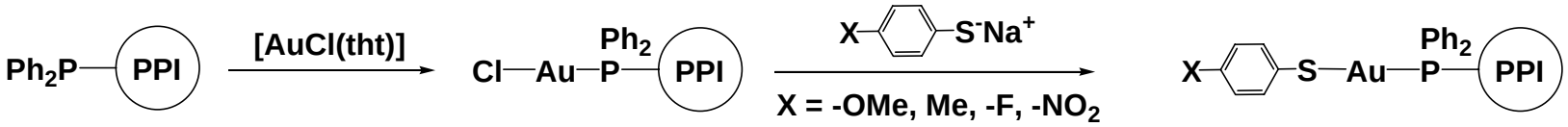
PPh_2-PAMAM-G1



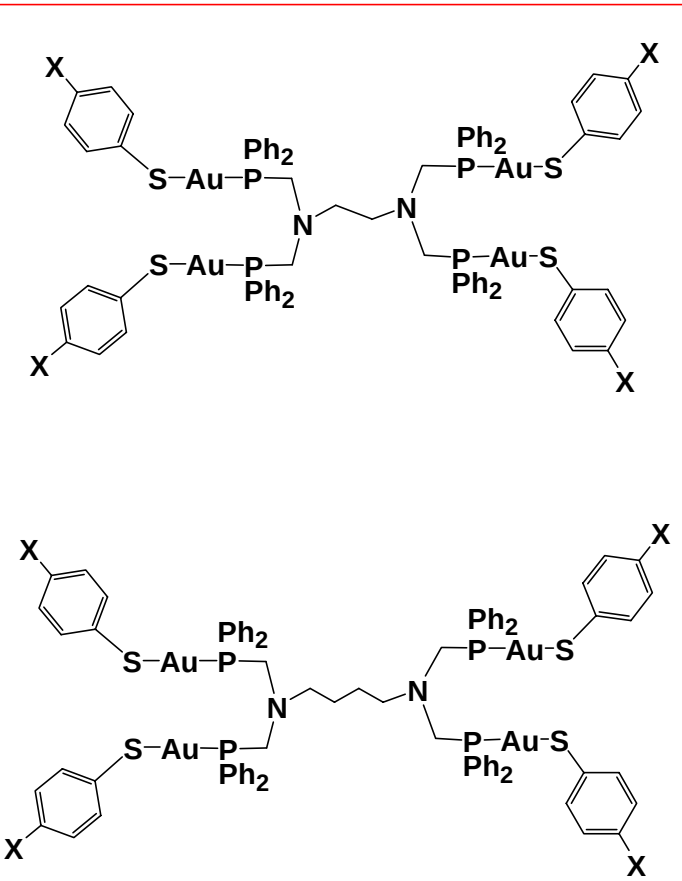
X =



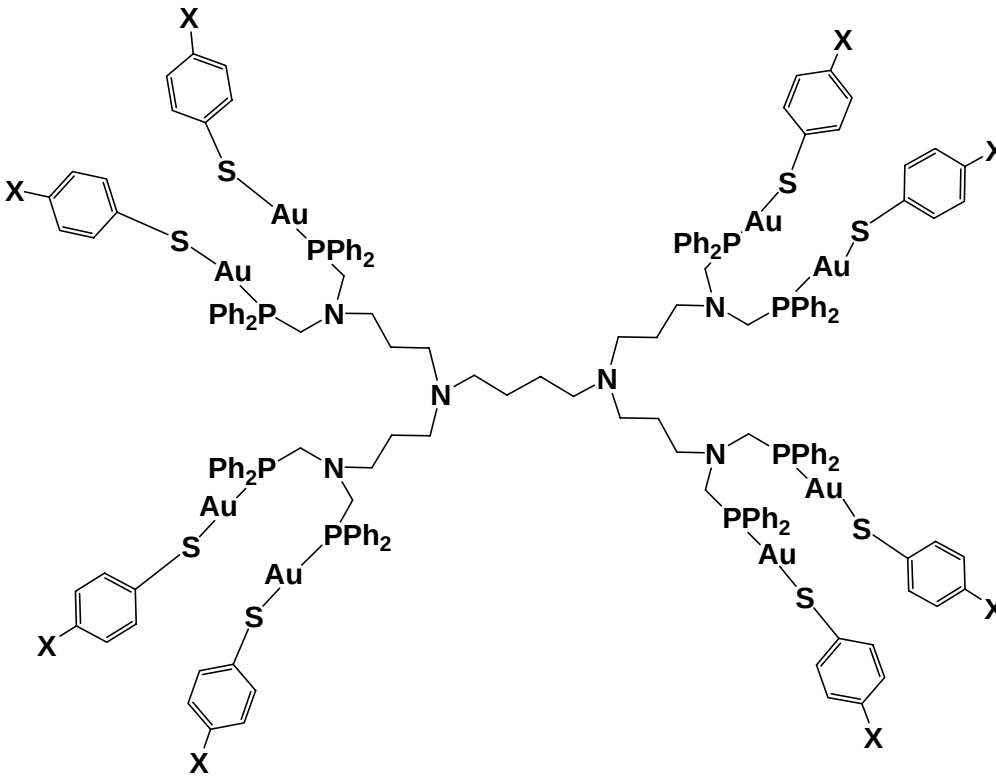
GOLD(I) PHOSPHINO THIOLATE COMPLEXES



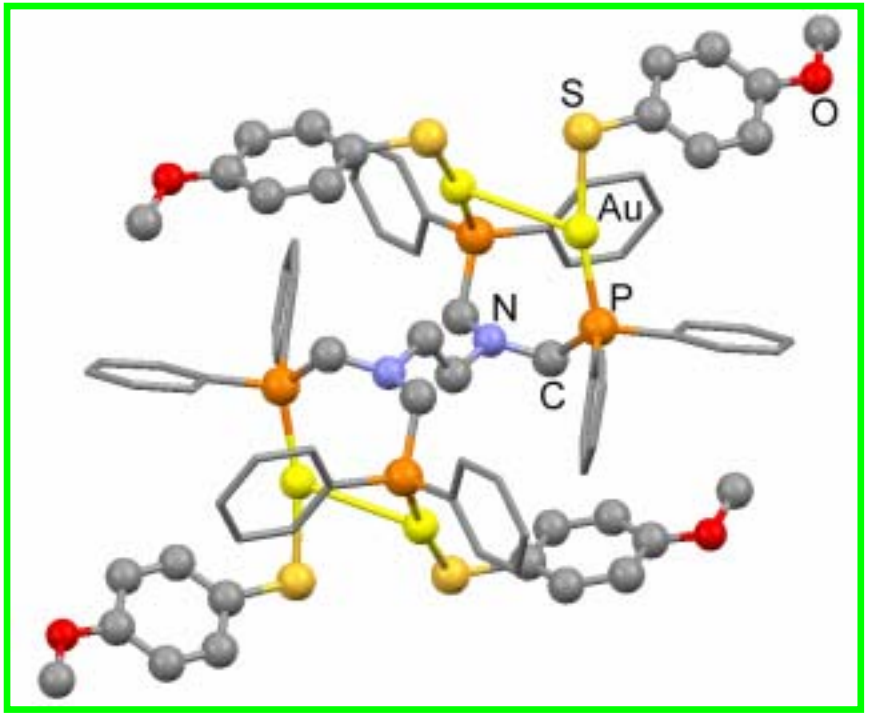
TETRANUCLEAR COMPLEXES

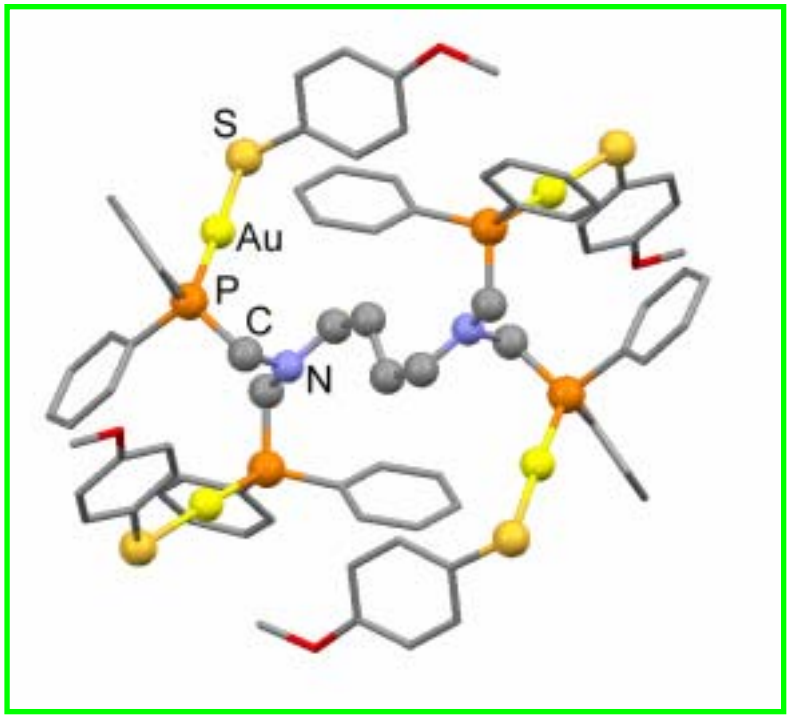


OCTANUCLEAR COMPLEXES (1ST GENERATION DENDRIMER)

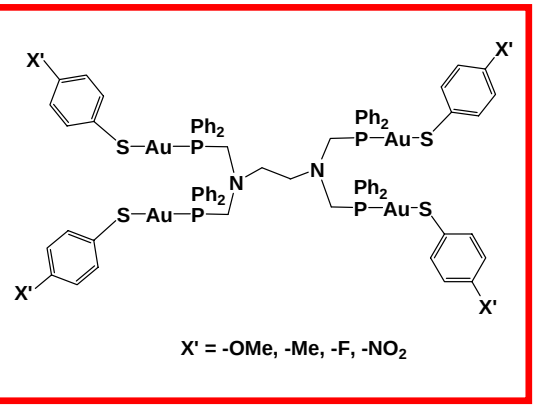


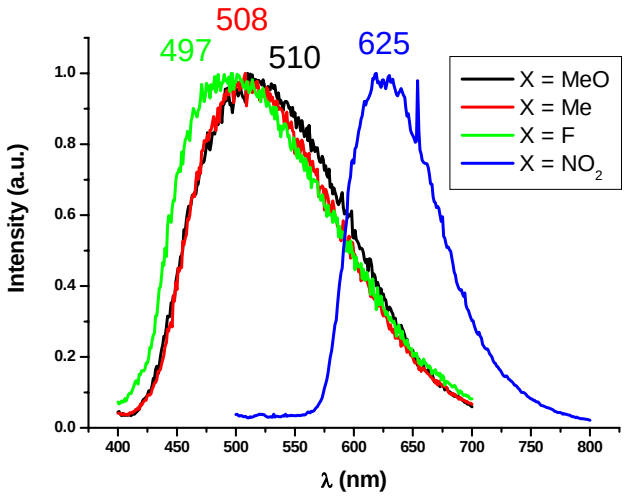
X-RAY STRUCTURES





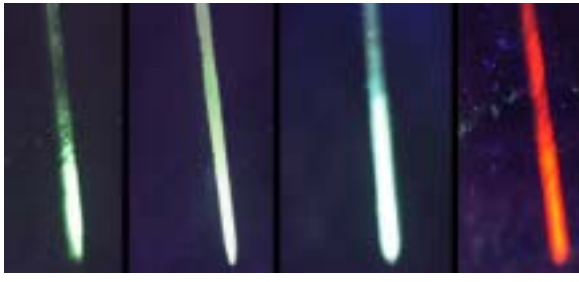
LUMINESCENCE

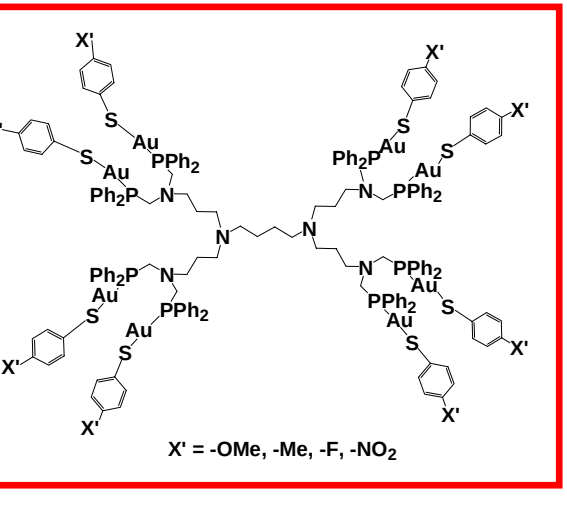


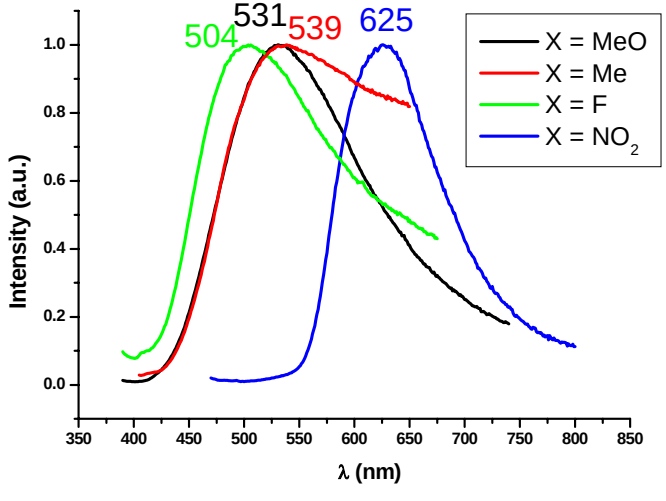


Emission lifetimes

MeO	Me	F	NO_2
37 µs	**30 µs**	**31 µs**	**866 µs**



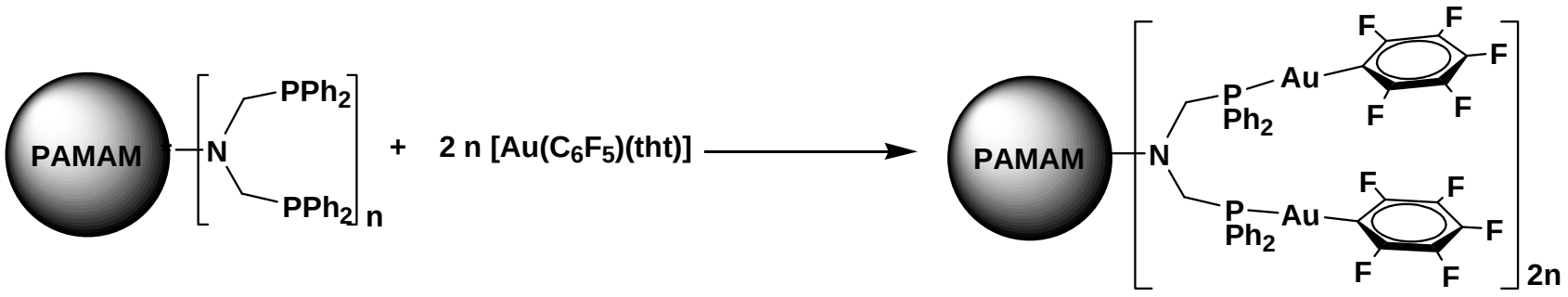




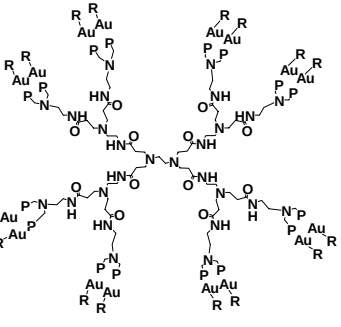
Emission lifetimes

MeO	Me	F	NO_2
15 µs	**21 µs**	**15 µs**	**391 µs**

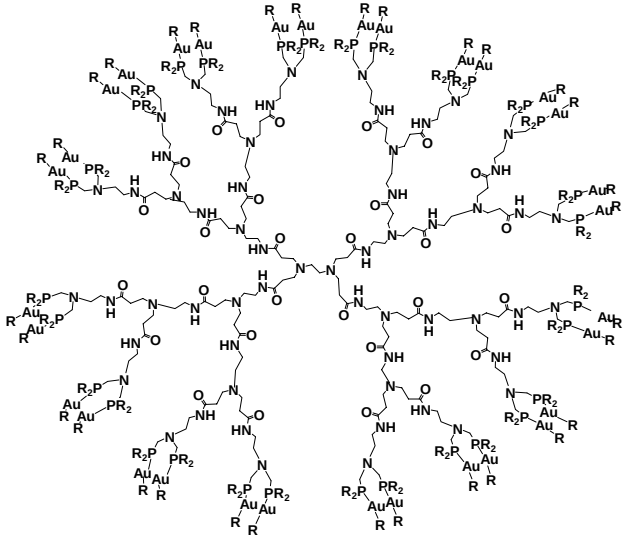
GOLD METALLODENDRÍMERS WITH 16, 32 AND 64 [Au(C_6F_5)] UNITS



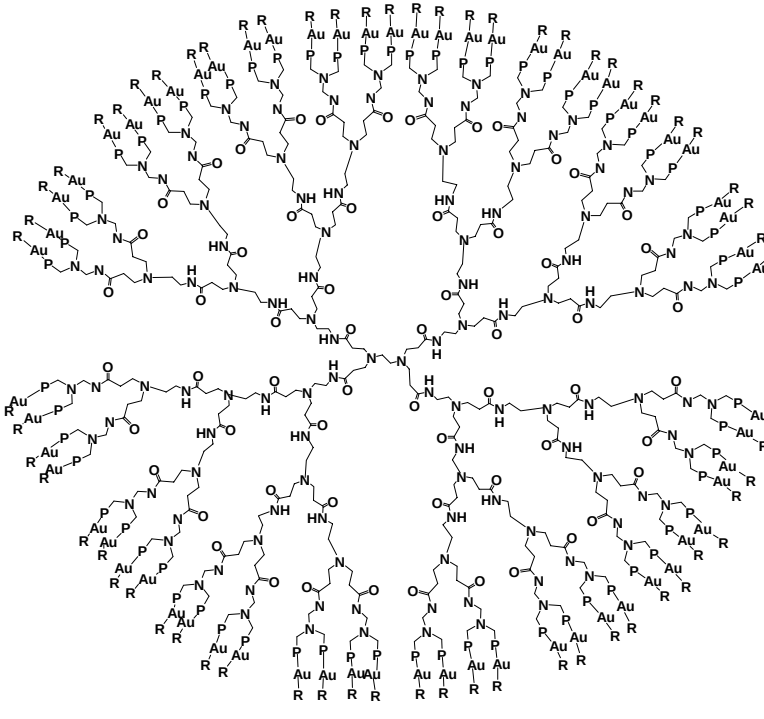
n = 8, 16, 32



AMAM-G1-PPh_2-[AuR]$_{16}$



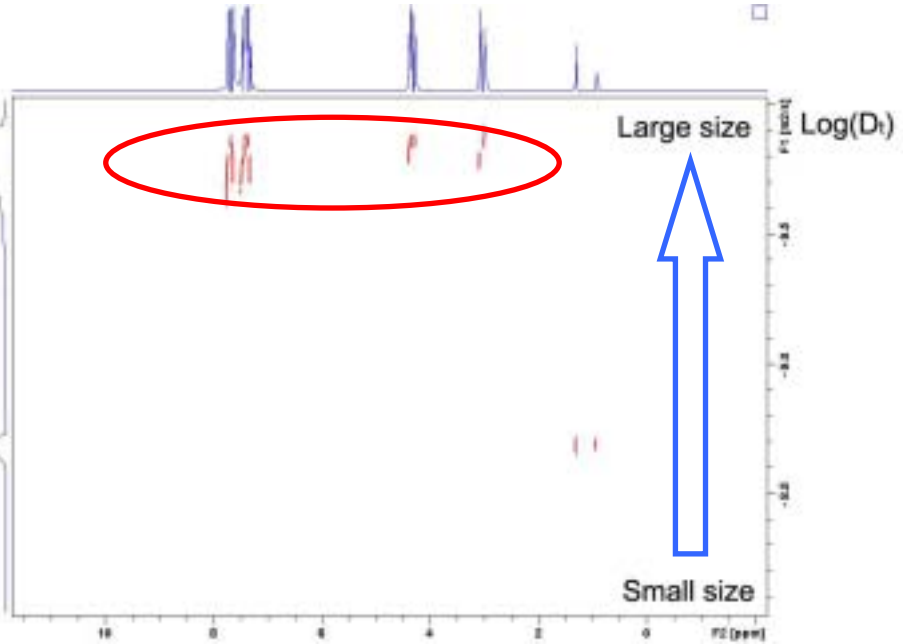
PAMAM-G2-PPh_2-[AuR]$_{32}$



PAMAM-G3-PPh_2-[AuR]$_{64}$

GOLD METALLODENDRIMER SIZE THROUGH PGSE-DOSY NMR

PGSE-DOSY NMR: determination of the traslational self-diffusion coeficient (D_t)

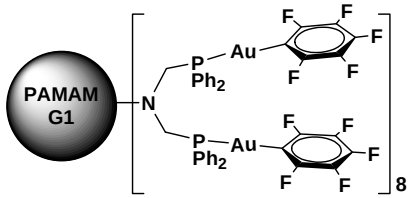


Stokes-Einstein equation:

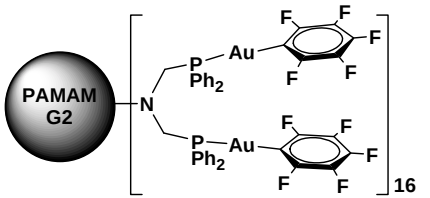
$$D_t = \frac{k_B T}{c \pi \eta R_H}$$

R_H = Hydrodynamic radius

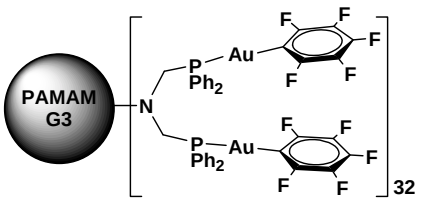
Diameter size



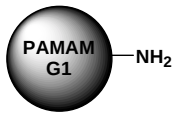
Au_{16} = 2.6 nm



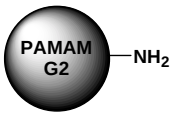
Au_{32} = 3.8 nm



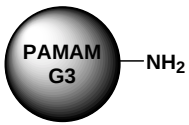
Au_{64} = 4.5 nm



1.9 nm

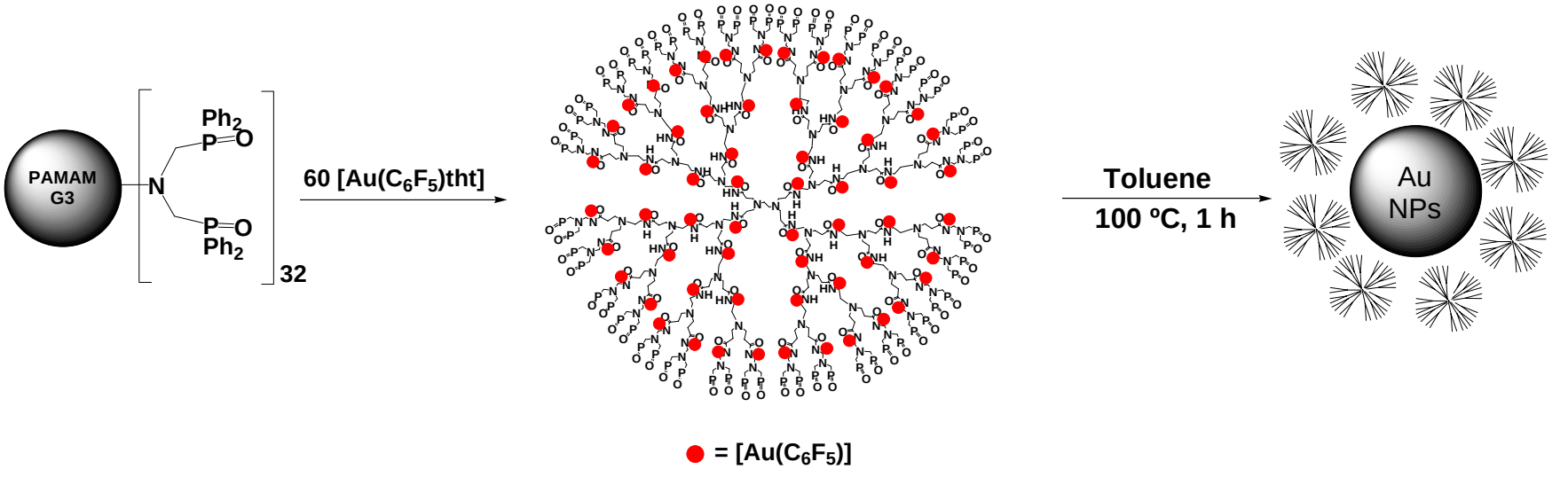


2.6 nm

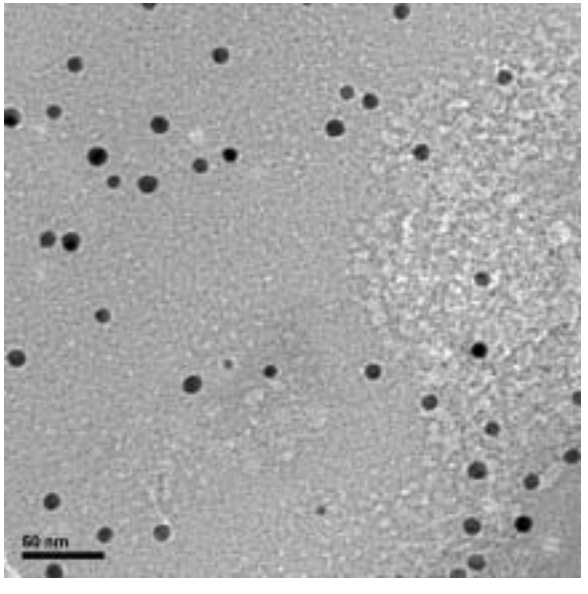


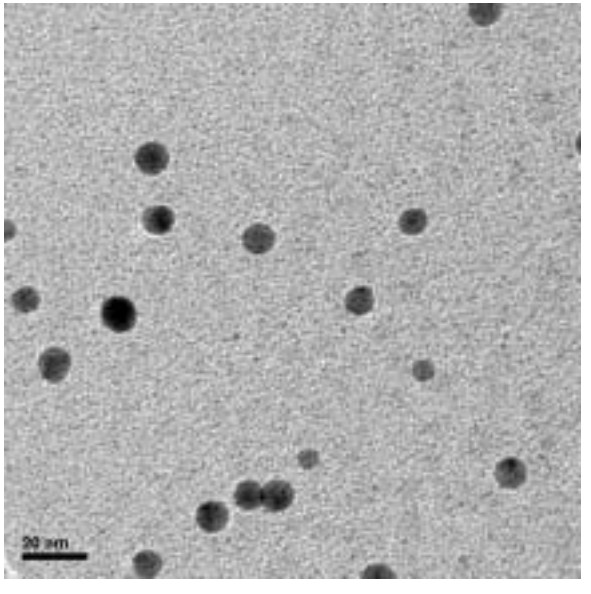
3.6 nm

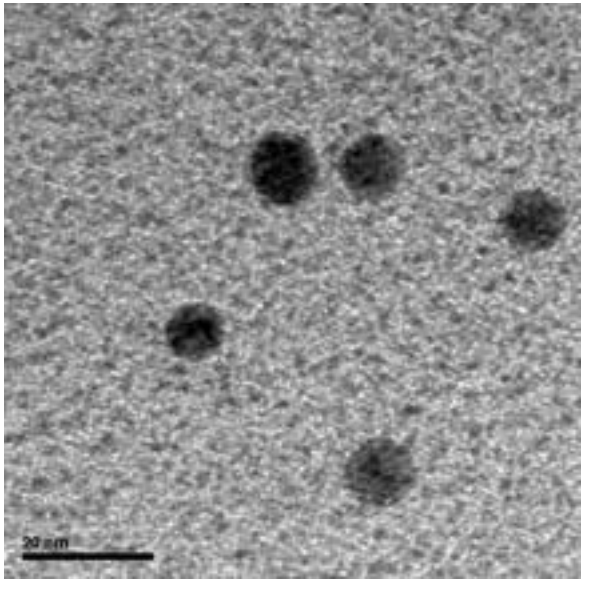
GOLD METALLODENDRIMERS AS PRECURSORS FOR Au NPs



Dendrimer stabilized Au nanoparticles (10 nm)







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