Applications and properties of lanthanide complexes

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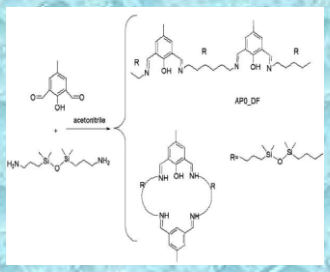
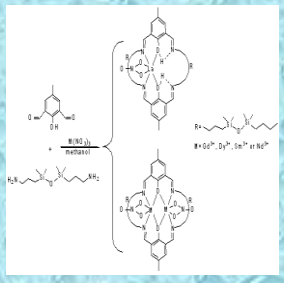
In the last time, experts estimate that industrial processes introduce up to a million different pollutants into the atmosphere and the aquatic ecosystem, and heavy metals are one group of these substances.

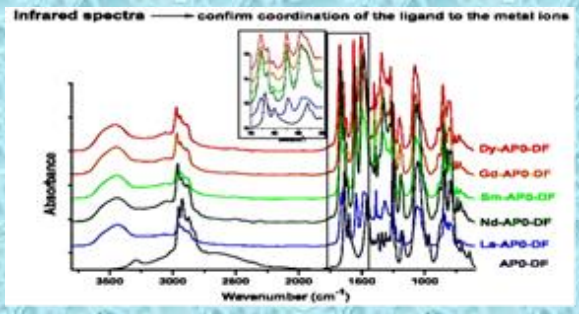
In this presentation the absorption (transient absorption) and emission (steady state and time-resolved fluorescence) spectroscopy were used to study, investigate and characterize the mechanisms of fluorescence quenching and obtaining new sensors for to detect toxic environments: heavy metals from water.

For this purpose, new compounds were synthesized for to have a good fluorescence (high quantum yield), stability and selective sensibility.

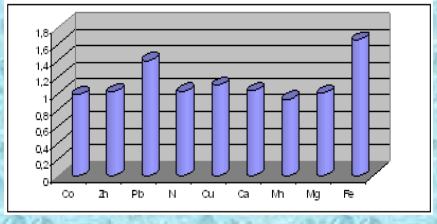




Macrocyclic ligand - obtained by the condensation reaction between siloxane diamine 1,3bis(aminopropyl)tetramethyldisiloxane (AP0) and 2,6-diformyl-4-methyl-phenol (DF) dialdehyde.
The lanthanide complexes were obtained by condensation between the siloxane diamine and dialdehyde followed by the addition of La, Gd, Dy, Nd, Sm in methanol at 1: 2 molar ratio as shown in scheme.

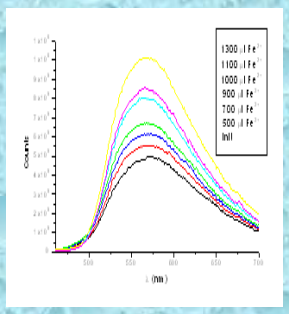


The study of fluorescence quenching by different metal ions such: Ni2+, Cu2+, Co2+, Zn2+, Fe3+, Mn2+, Ca2+, Pb2+, Cr3+, Cd2+, Sr2+, Mg2+ will be in solution, film for to demonstrate that these samples have a good stability and they can be used as fluorescence sensors for the selective detection of metal ions

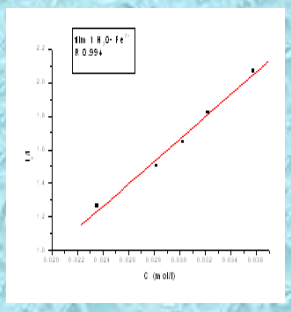


Quenchers- metal ions and the sensibility of these at the Film APO DF/H2O

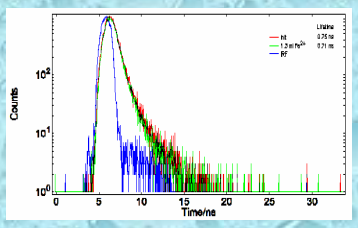
For fundamental study, theory of dynamic quenching, theory of static quenching and combined dynamic and static quenching were used, and constants of the process, the lifetime in excited state, the quantum yield were estimated and depend on the substitution of metal ions.



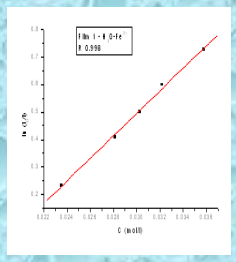
The fluorescence quenching of Film APO DF/H2O



The linear Stern-Volmer plot of Film APO DF/H2O



Film APO DF/H2O



The Perrin model of Film APO DF/H2O

Determination of quantum yield, and lifetime in solution and film

Samples	Q.Y(%)	t1 (ns)	A1 (%)	t2 (ns)	A2 (%)
Solution DMF					
AP0-DF-La3+	3.70	1.562	15.09	3.778	84.91
AP0-DF-Nd3+	1.87	0.385	29.53	3.646	70.47
AP0-DF-Sm3+	2.20	0.333	26.27	3.554	73.73
AP0-DF-Gd3+	2.90	0.307	41.11	3.633	58.89
AP0-DF-Dy3+	2.70	0.297	51.58	3.365	48.42
AP0-DF	1,60	0.2814	86.22	2.8133	13.78
Film					
AP0-DF-La3+	3.43	0.687	90.4	2.428	9.6
AP0-DF-Nd3+	1.36	0.773	85.14	3.835	14.86
AP0-DF-Sm3+	2.99	0.929	46.7	3.163	53.3
AP0-DF-Gd3+	2.88	0.914	51	3.482	49
AP0-DF-Dy3+	3.02	1.203	35.33	3.558	64.67
AP0-DF	19.94	0.6288			

A new application of the compounds investigated for detection of toxic environments was obtain, sensor for to detect Fe from water.