Ph.D. defense

Institut de Chimie Séparative de Marcoule / CEA Marcoule
(UMR 5257, CEA, CNRS, Université Montpellier 2, ENSCM)

DAMIEN BRUSSELLE

will present his Ph.D. dissertation

Self-assembly of dicarbollide molecules in aqueous solution: a new kind of surfactant

The defense will take place on **Monday, December 16, 2013** at **2:00 pm**

in the ICSM Auditorium

Metallacarboranes are anionic clusters composed of boron, carbon and hydrogen with a metallic cation sandwiched in the core of this cluster (Co^{3+} for COSAN, Cobalt Sandwich) with a remarkable thermal and chemical stability. We have extended our study on various Metallacarboranes derivatives synthesized partially in the laboratory and in collaboration with a team expert in this chemistry at the university of Barcelona (CSIC-ICMAB). It is indeed possible to substitute specifically some hydrogen atoms by iodine or chlorine atoms or to change the metallic core with others cations from the transition metal series (Fe, Co, Ni, Cu). In this thesis work, binary systems with diiodo- COSAN (I2COSAN), dichloro-COSAN (Cl2COSAN) and ferrabisdicarbollide (FESAN) anions in water were investigated. It was demonstrated that these types of molecules can be considered as a new class of surfactants with amphiphilic properties at water/air interface as well as in bulk water. Using scattering techniques as well as electronic microscopies and surface tension measurements, it was shown that they can self-assemble forming a large panel of lyotropic stuctures, isotropic like diluted vesicles or concentrated micellar phases and and smectic with La or Lb lamellar phases depending on concentration, temperature and the cluster chemistry. It has also been demonstrated that the inter-cluster hydrogen bounds are at the origin of the self-aggregation with the particularity to form monomolecular film, a peculiar structure only observed for covalent aggregates.

Unlike the classical surfactant composed with two antagonist parts, a polar head and a lipophilic chain, these type of molecules can be schematically represented by the Greek letter “theta” where the both parts are not clearly define but for which a negative and delocalized charge in excess is counter-balanced by an acidic proton.

Their various chemical and physical properties bring to this class of molecules a particular interest in applications such as the co-extraction of Cs and Sr in nuclear waste retreatments or in medicine for their ability to inhibit enzymatic reactions. However, owing to the richness of the bore chemistry, the application could be extended to nanoscience and nanotechnologies by exploring their magnetic and optical properties.