Ph.D. Résumé: P. André

Used for copper metal nanoparticle synthesis, the ternary system constituted by a solution of $Cu(AOT)_2$-water-isooctane is studied in the region rich in oil. When surfactant concentration and water amount evolve, various structures are obtained, spheres, cylinders, lamellae, spherulites... The overall phase diagram does not evolve with time or temperature cycle. Furthermore, we show inside a single phase the coexistence of lamellar and cylindrical structures. Characteristic distances associated to both structures have totally different range of order. This requires to redefine the notion of phase, which was considered until now as a single structure. The geometrical model is extended to reverse micellar systems. It authorizes a detailed description of the microstructures. For high water content, it is possible to forecast the spherulite disappearance. In the cylindrical and lamellar structures, it is possible to show that surfactant hydration is kept constant, whereas the overall water increases in the micellar system. At least, the structural transition from interconnected cylinders to spheres is predicted through simple geometrical considerations. For sure, the geometrical model limits are reveled, for example to predict the proportions of the various phases in equilibrium.

In order to study the optical responses of individual copper metal nanocrystal, two types of Near-Field Optical Microscopy are used. The first combines STM tip and optical excitation of surface plasmon associated to thin metal films. In this Kretschmann configuration, we bring existence evidences of coupled modes between the tip and the surface. This requires to increase the precautions used to interpret optical measurement by means of apertureless optical near-field microscope involving a surface plasmon. To get ride of this handicap, a photosensitive polymer is used. A laser beam linearly polarized interferes with nanocrystal island radiation and induces modulations at the polymer surface. These modulations are analyzed due to a simple AFM in contact mode. Coupled modes between two islands, interferences with butterfly and almond shapes are recorded. Theses are in good agreement with dipolar radiation calculation. We show that the optical response of copper metal nanocrystal islands is mainly dipolar and that the optical response of a single copper metal nanocrystal is accessible due to a simple record on a polymer photosensitive film.