# GOLD COATED FECO NANOPARTICLES WITH TAILORED FUNCTIONALIZED SURFACE FOR BIOLOGICAL APPLICATIONS.

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Nanoparticles of a 1-100 nm size have broad applications in biology. Gold nanoparticles have been long used for applications in labelling and more recently as probes for identifying specifically gene sequences or molecules using SERS.[1] Magnetic nanoparticles, on the other hand, have been largely studied for their potential use in a wide range of biomedical applications such as targeted drug delivery, magnetic separation, imaging or hyperthermia. Nano-probes combining targeted delivery and magnetic separation with specific detection would be tools of choice as technologies for the detection of biological targets, especially bacteria, are being developed for applications to public health, agriculture, ecological health and international security.[2,3]
Two of the necessary requirements for such nano-objects are their bio-compatibility and their solubility in a physiologic, i.e. aqueous, medium. A core-shell architecture consisting of a magnetic nano-core surrounded by a gold shell displaying a tailored surface fonctionalization would provide both magnetic and optical properties necessary for magnetic manipulation and plasmonic sensing, and biocompatibility and stability.
Over the last decade most of the studies in the literature have been dedicated to the synthesis of iron oxide or core-shell $Fe_3O_4/SiO_2$ nanoparticles as magnetic nanobio-tools.[4,5] Although these NPs are being considered now for a variety of applications, the low magnetic moment of $Fe_3O_4$ combined with the presence of $SiO_2$ coating yields poor global magnetic properties and strongly limits their performances. FeCo shows a very high magnetic moment but the synthesis of stable nanoparticles has proved to be very difficult and the toxicity of Co is a real issue for a biological application. We report here a one pot synthesis of core-shell gold coated FeCo nanoparticles having 8 nm superparamagnetic core and 2 nm gold shell that insures the confinement of the Co atoms and hence the biocompatibility. The synthesis, carried out in an organic media, yields water-insoluble nanoparticles. Still, a specific surface treatment led to water soluble particles (fig 1). These particles were then bio-conjugated with sdAb targeting staphylococcus aureus bacteria via a 2-step coupling of proteins process using EDC and sulfo-NHS.
The FeCo@Au water soluble nanoparticles have also been coated with $SiO_2$. This shell, which thickness is tuneable (20 to 40nm), is further functionalized with amine groupements allowing the investigation of their brain-cancer MRI potential.

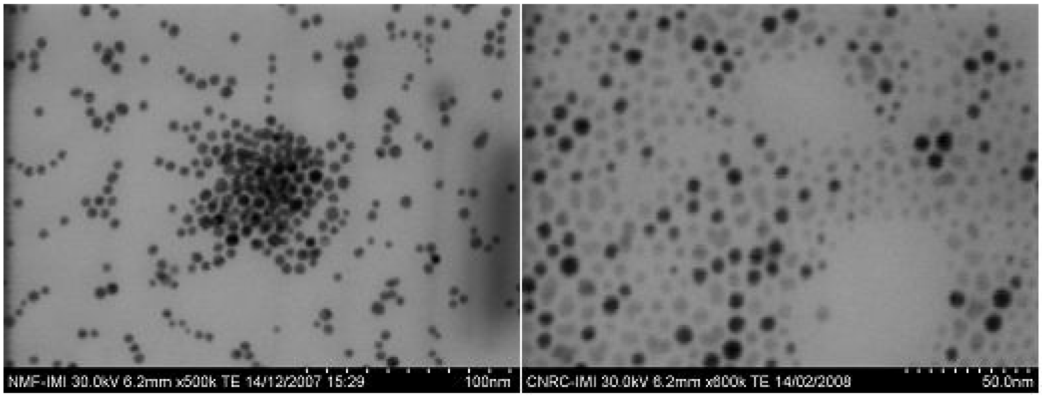


**Figure 1.** STEM micrographs of FeCo@Au nanoparticles : after synthesis in hexane (left) and after surface functionalization in water (right).

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