Exploring the sub-nanometer scale in magnetic materials with the microemulsion technique

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Most of materials show a dramatically change in their properties at the nanometer/subnanometer level. In particular, metallic clusters ("particles" formed by $N_{atoms} < 100$ atoms) are one of the most promising and exciting research areas because they combine the scientific with the application interest. From the scientific point of view, there are many controversial points about the exact stability, structure/geometry and properties of these tiny nanoparticles. For example, according to theoretical calculations, different geometries -very different from the bulk- seem to be stable: for $N_{atoms} < 10/12$, planar geometries are preferred, whereas for $N_{atoms} > 10/12$, 3D structures with compact, non-compact and five-fold symmetries are found to be the most stable ones, depending upon the conditions and approximations used for the theoretical calculations[1]. A number of new fascinating properties seem to appear at these scales. As an example, fluorescence[2], catalysis[3], magnetism[4], and circular dicroism[5] have been already reported. However, all these studies are very limited because of the procedures used for the cluster synthesis. Only very small amounts of highly polydisperse samples can be obtained after difficult separation procedures[6]. We have recently developed a novel method for the synthesis of clusters which allows their production in relatively large amounts[7-8].

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