

Magnetofluorescent Nanoparticles: a Reverse Approach for High-Loaded Active Materials

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Introduction

Magnetofluorescent nano-objects have recently stirred considerable interest in biological imaging. Both magnetic and optical addressing methods offer the combined advantages of remote vectorization and high sensitivity through light detection, respectively. The usual architecture consists in doped silica nanoparticles or core-shell structures where an inorganic magnetic core is surrounded by fluorescent units. The main limitations of these systems generally rely on spatial dilution of the active units or strong interactions with the surroundings, which is likely to quench the emissive excited state by energy, electron or proton transfer.

Material and Method

We have thus developed organic non-covalent fluorescent nanoparticles (FON)¹ which can serve as fluorescent platforms for hybrid magnetofluorescent nanoparticles² and exhibit weak sensitivity to biological media. Compared to free dyes in solution, they provide higher emission contrast thanks to a high load of active units estimated at around 10^5 - 10^6 molecules per nanoparticle. The stability provided by these amorphous nanoparticles in media of various ionic strength and pH makes them particularly attractive for biological imaging.

Results

The synthesis of amphiphilic triarylamine compounds with complexing units³ allowed us to generate FON (40-80 nm in size) with large linear or non-linear optical coefficients in the red and near infrared range. A straightforward procedure was developed to obtain stable and tunable organic nanosphere by reprecipitation in aqueous solution. This one-step procedure could be applied to organic molecules with distinct terminal units like carboxylic or phosphonic acids, able to complex iron oxide nanoparticles. Hybrid magnetofluorescent nano-assemblies (50–180 nm) have thus be simply elaborated by reprecipitating the complexing organic derivatives in iron oxide nanoparticle solution⁴ instead of water, and display high response to a magnetic or optical field excitation (Figure 1).

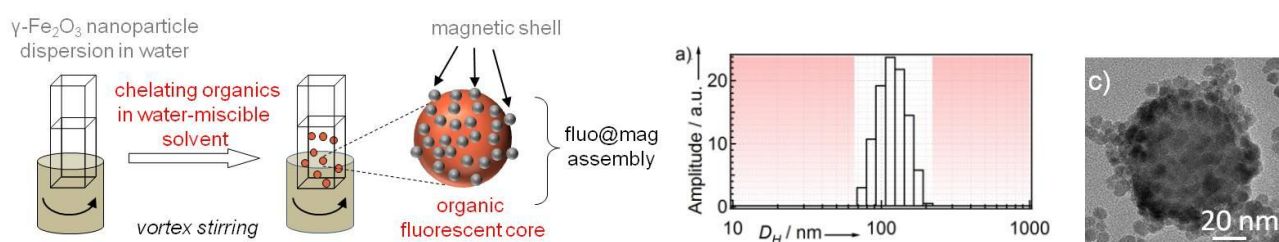


Figure 1 : Schematic description of the fabrication method to yield magnetofluorescent nanoparticles. TEM imaging and distributions of the mean hydrodynamic diameters D_H .

Conclusion

To the best of our knowledge, organic nanoparticles made of small organic molecules coated with iron oxide nanoparticles represent an innovating structure which has never been realized in spite of their vectorization properties. *In-vitro* assays are currently being performed to infer the potential ability as biological probes of this new class of core-shell structure, dubbed fluo@mag.

References

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