Synthesis of aminated magnetite nanoparticles and their interaction with biomembrane models

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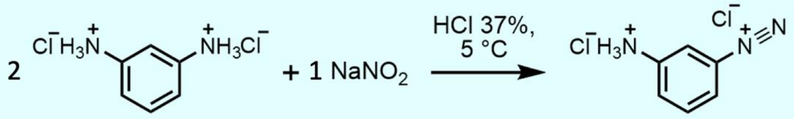
Introduction.

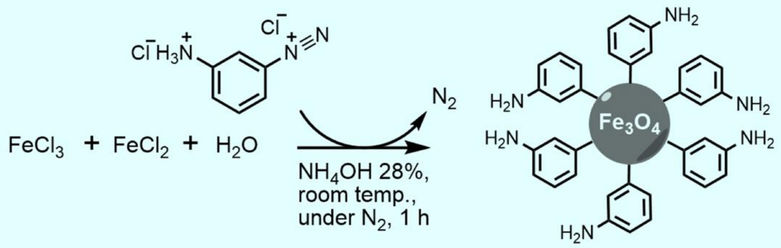
Ferrimagnetic iron oxide nanoparticles (Fe_3O_4 NP) are versatile materials with promising biotechnological applications, such as separation and recycling, (bio)sensing, (bio)catalysis; and also in heath treatments. Fe_3O_4 NP are suitable for these applications due to their biocompatibility, relatively low toxicity, superparamagnetism, and the versatility for surface modification. Surface functionalization of Fe_3O_4 NP offer a wide range of possibilities to obtain materials with improved dispersibility and stability in colloids, facilitating specific interactions or recognition capabilities, *i.e.,* with lipid Langmuir monolayers as biomembrane models.

Synthesis of Fe_3O_4-$ArNH_2$ NP

1) Synthesis of 3-phenylenammonium-1-diazonium dichloride



2) Co-precipitation of Fe salts and covalent binding of arylamine groups onto magnetite

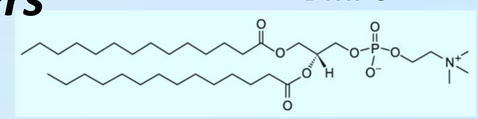


Purification
2 cycles with water and 11 cycles with ethanol consisting of dispersion for 15' and centrifugation at 5000 rpm for 15'

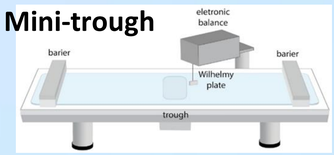
N. Griffete, *et. al. Colloids Surfaces A Physicochem. Eng. Asp.*, **2012**, *415*, 98–104.

Interaction with Langmuir monolayers

DMPC



Mini-trough

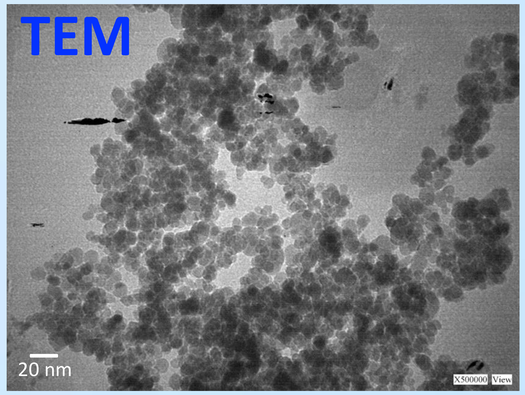


1. Increasing volumes of a 0,5 mg/mL dispersion of F_3O_4-$ArNH_2$ NP are mixed with water at pH 3.0 in a Langmuir mini-trough.

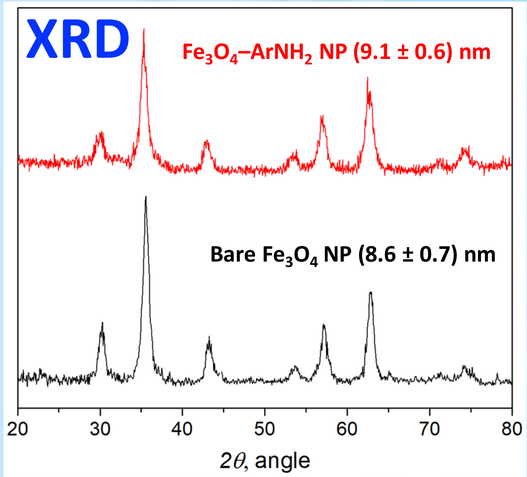
2. The same amount of amphiphilic DMPC is spread onto the surface of the different diluted and concentrated mixtures of NP-water.

3. Lateral barriers start compressing the surface and isotherms of surface pressure-area are measured.

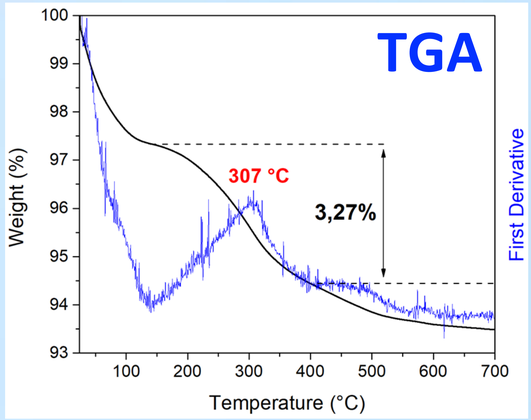
Characterization of Fe_3O_4-$ArNH_2$ NP



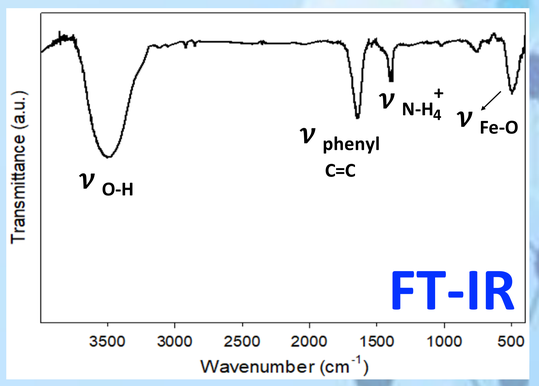
TEM image of NP show spherical shapes.



Powder X-ray diffraction peaks of both NP show identical patterns, which match with magnetite. Covalent binding of arylamine groups on NP surface does not affect magnetite crystal structure.



Thermal decomposition analysis indicates loss of Fe_3O_4-$ArNH_2$ NP the arylamine coating at 307 °C. Further heating over 400 °C shows Fe_3O_4 phase transitions. Arylamine coating on Fe_3O_4 NP is 3.27%.



Fe_3O_4-$ArNH_2$ NP displays Fe-O stretching vibration band at 500 cm^{-1} and a strong O-H vibration at 3500 cm^{-1}. The presence of arylamine is confirmed with phenyl C=C vibration at 1640 cm^{-1}. Ammonium N-H vibration used in the synthesis appears at 1393 cm^{-1}.

Acknowledgements.

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Conclusions.

Fe_3O_4 NP of magnetite with surface modification with arylamine groups was successful. Regarding NP interaction with DMPC Langmuir monolayers as a biomembrane model, there is no detectable change in the surface pressure-area of DMPC for the evaluated concentration range of F_3O_4-$ArNH_2$ NP. It is possible that 3.27% of arylamine groups on the NP surface is not enough to cause a measurable change.