

Iron oxide nanoparticles for biomedical applications

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MAIN RESEARCH LINES

1. Spherical iron oxide nanoparticles for applications in drug delivery and magnetic hyperthermia

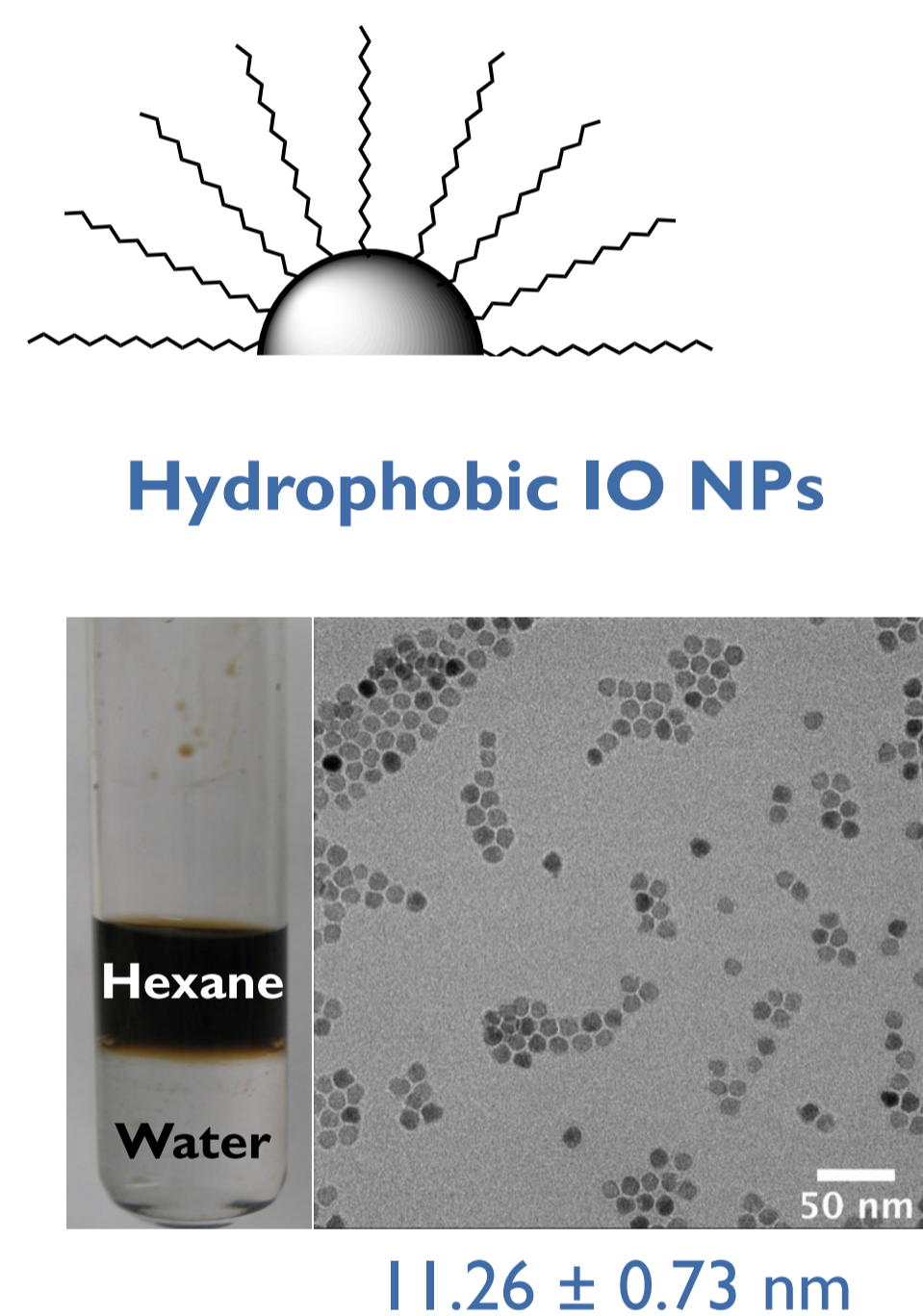
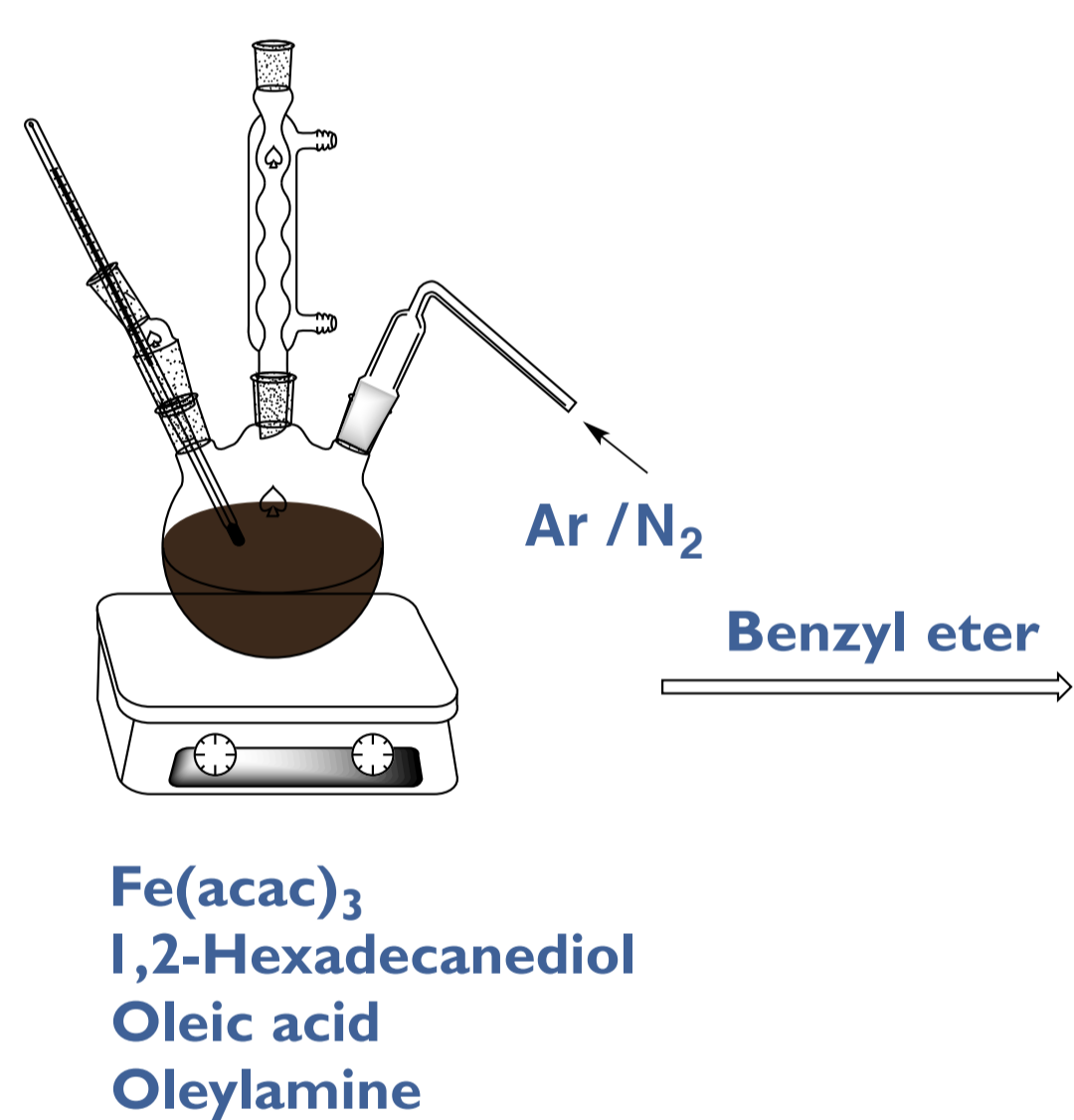
- ✓ Nanomaterials for biomedical applications must display low toxicity, high stability in physiological media, controlled interaction with biological entities such as proteins and cell membranes and ability to overcome the immune system.
- ✓ **Amphiphilic polymers** (poly(maleic anhydride-*alt*-1-octadecene) – PMAO; poly(isobutylene-*alt*-maleic anhydride) – PIMA) are used for the transfer of monodisperse iron oxide nanoparticles (IO NPs) to water and provide reactive groups for their further functionalization with biomolecules.^{1,2,3,4}

2. High aspect ratio magnetic nanomaterials

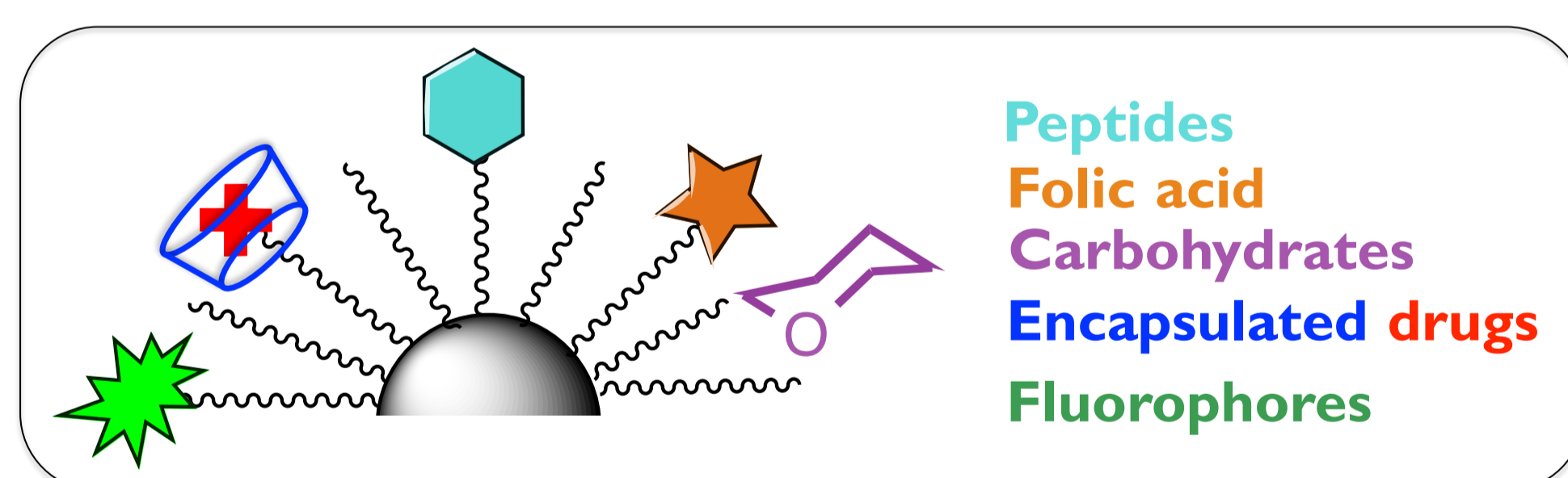
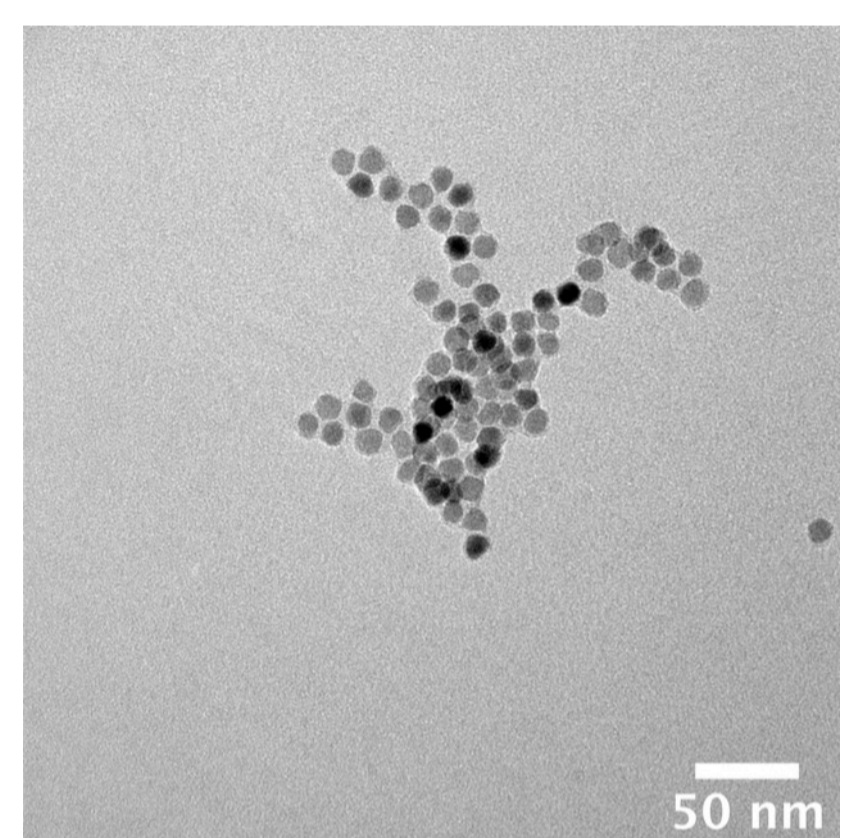
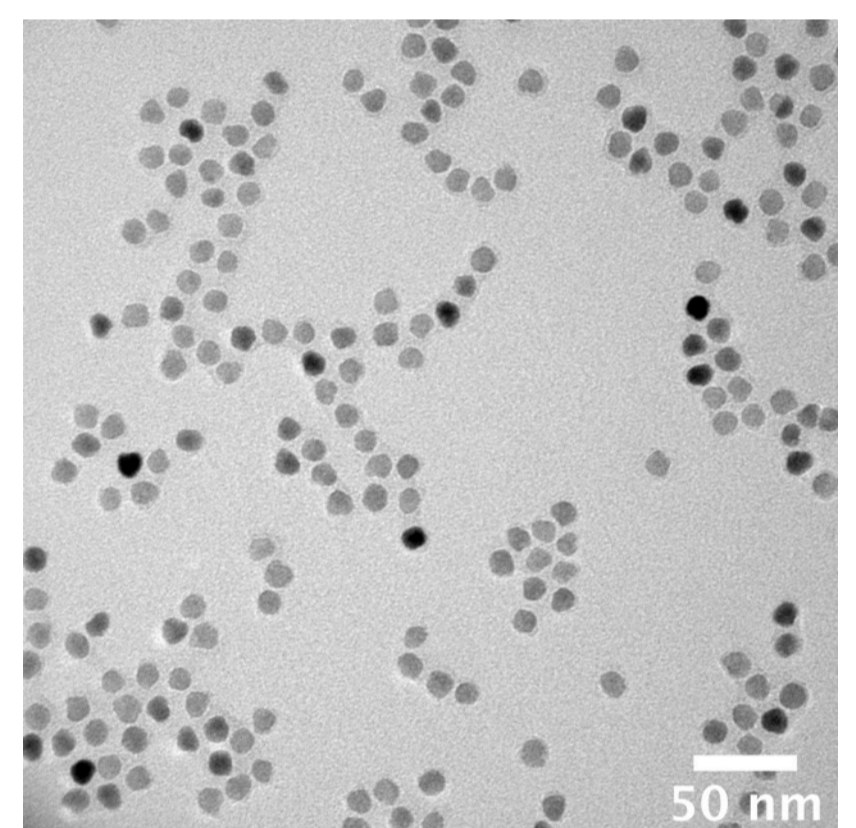
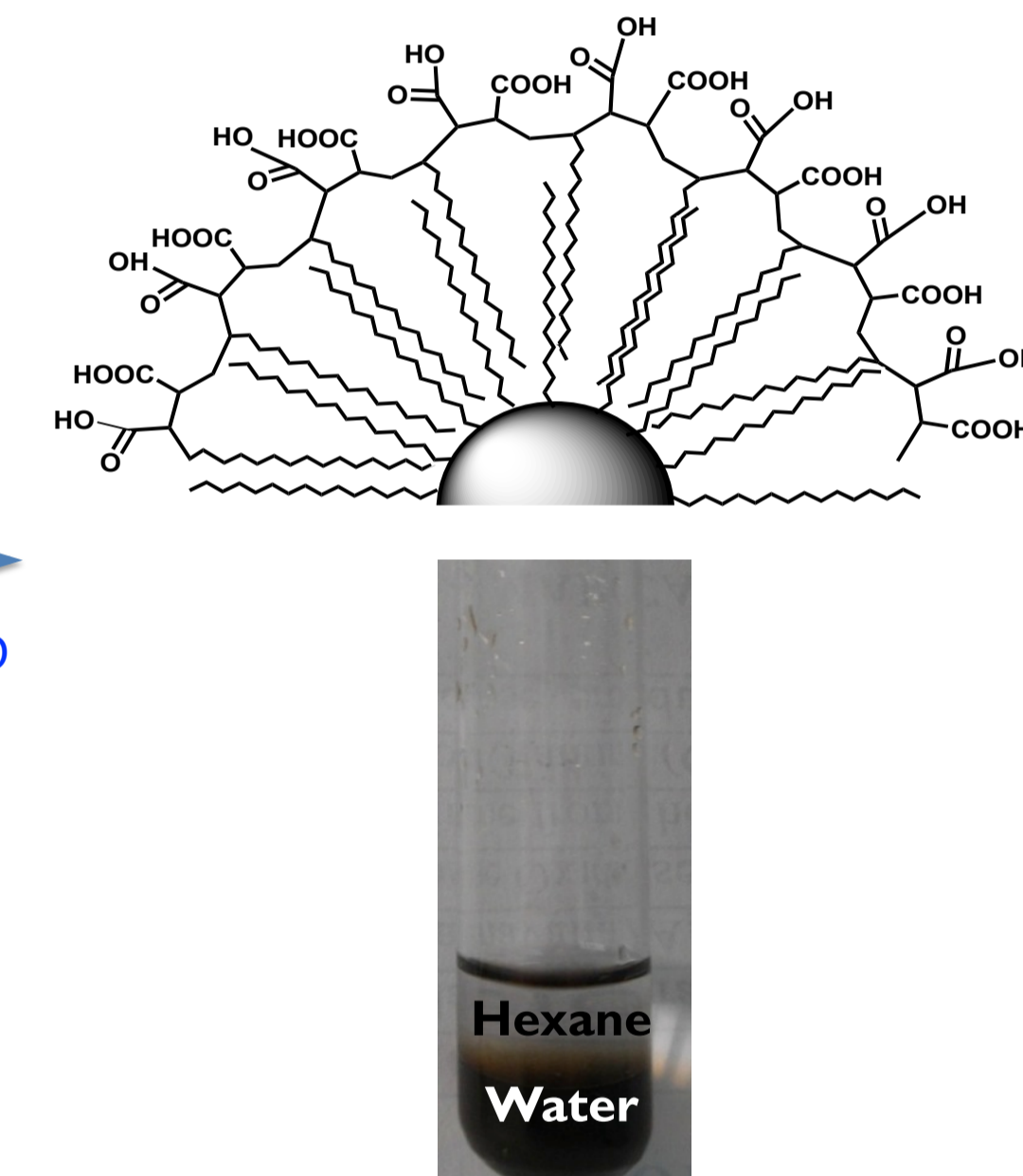
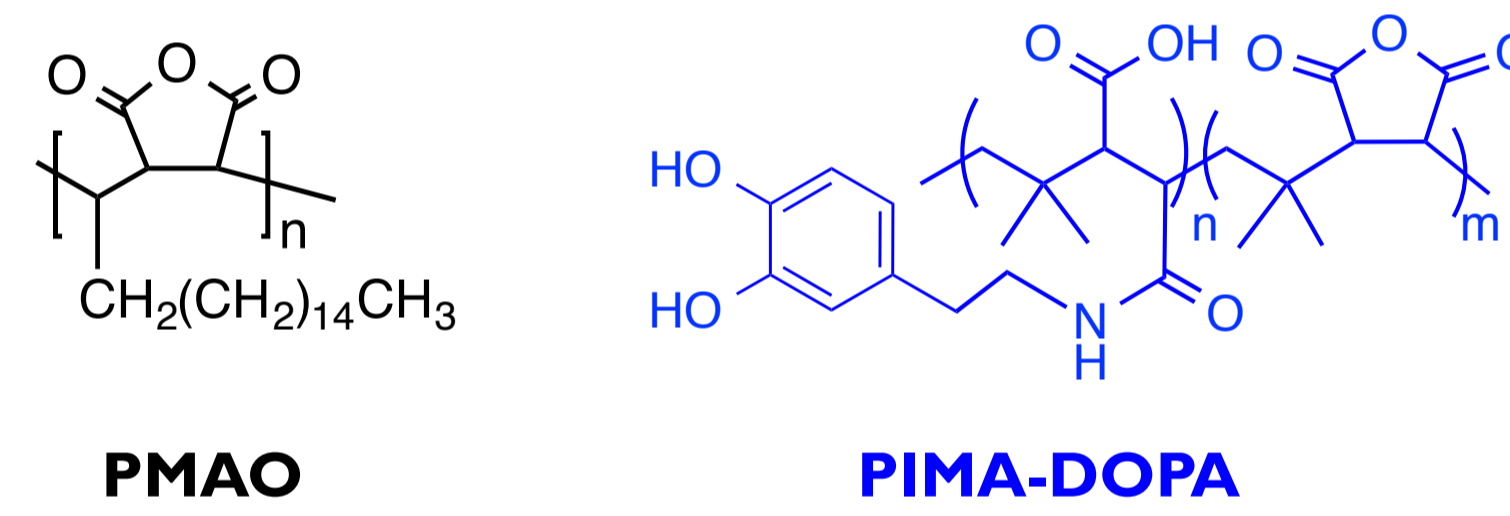
- ✓ Three key advantages compared to conventional spherical nanoparticles: increased surface area, longer blood circulation times and enhanced magnetic relaxivity.⁵
- ✓ We seek to synthesize **iron oxide nanoworms** for applications in magnetic hyperthermia and drug delivery and imaging across the blood-brain barrier.

SYNTHESIS AND FUNCTIONALIZATION OF IRON OXIDE NANOPARTICLES

SPHERICAL IO NPs



1. Coating with amphiphilic polymers (PMAO, PIMA-DOPA) 2. Hydrolysis of anhydride groups (OH⁻)



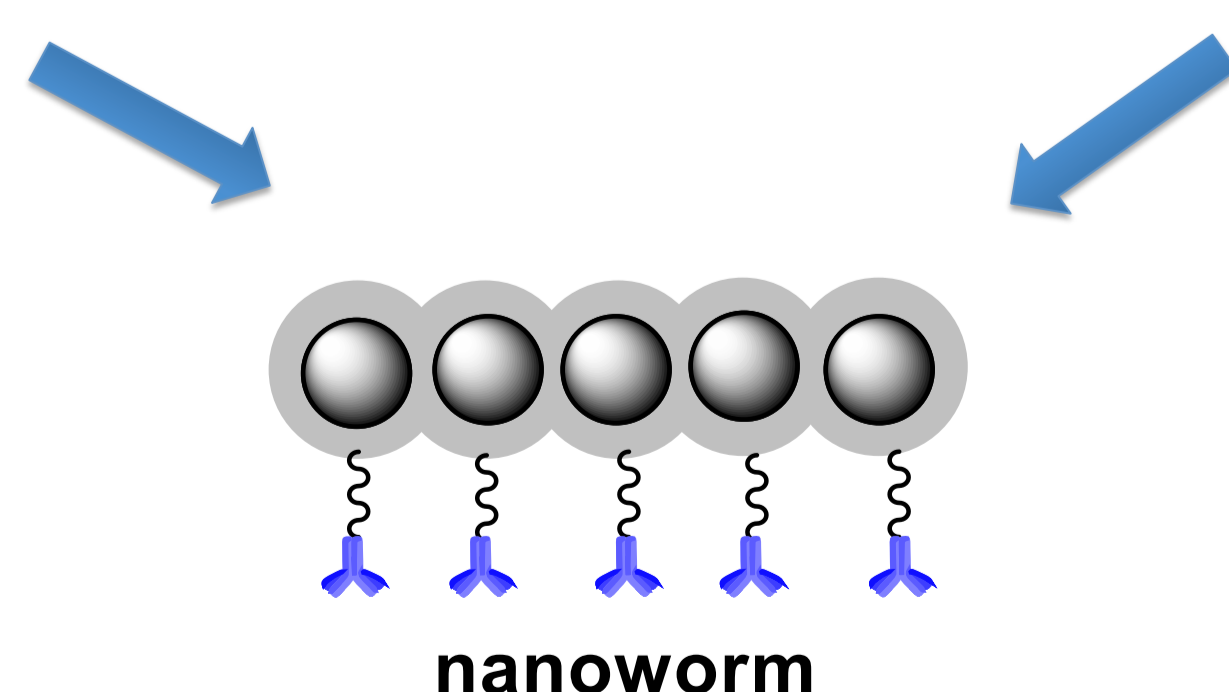
Multifunctional IO NPs for targeted drug delivery, magnetic hyperthermia and magnetic resonance imaging

3. Biofunctionalization

HIGH ASPECT RATIO IO NPs (NANOWORMS)

Large surface area = multivalent interactions between the targeting ligands and the receptors

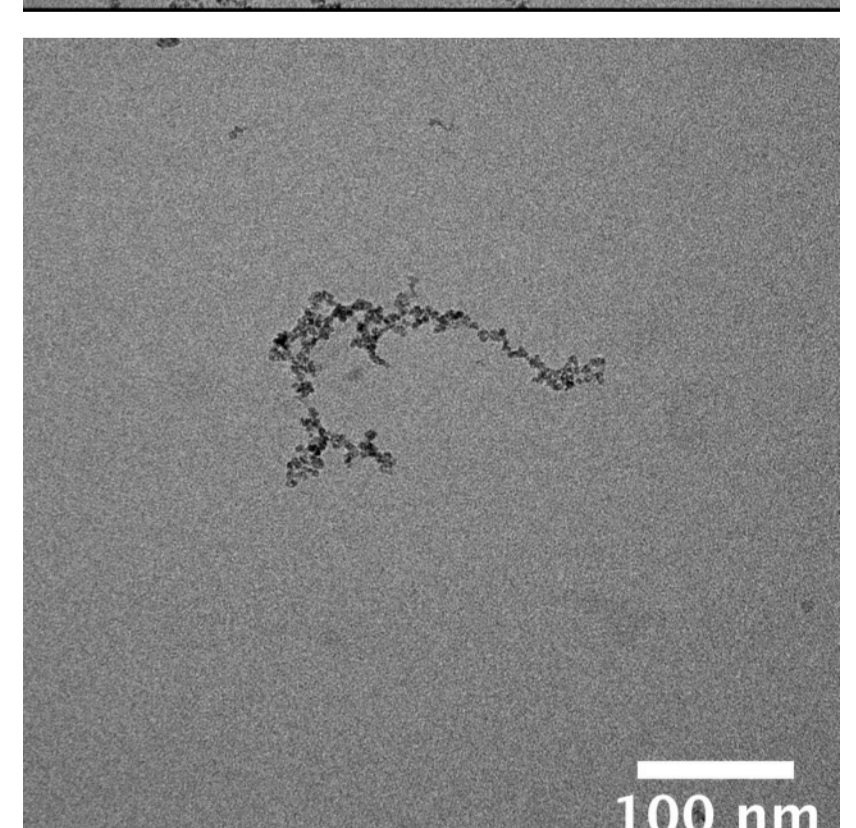
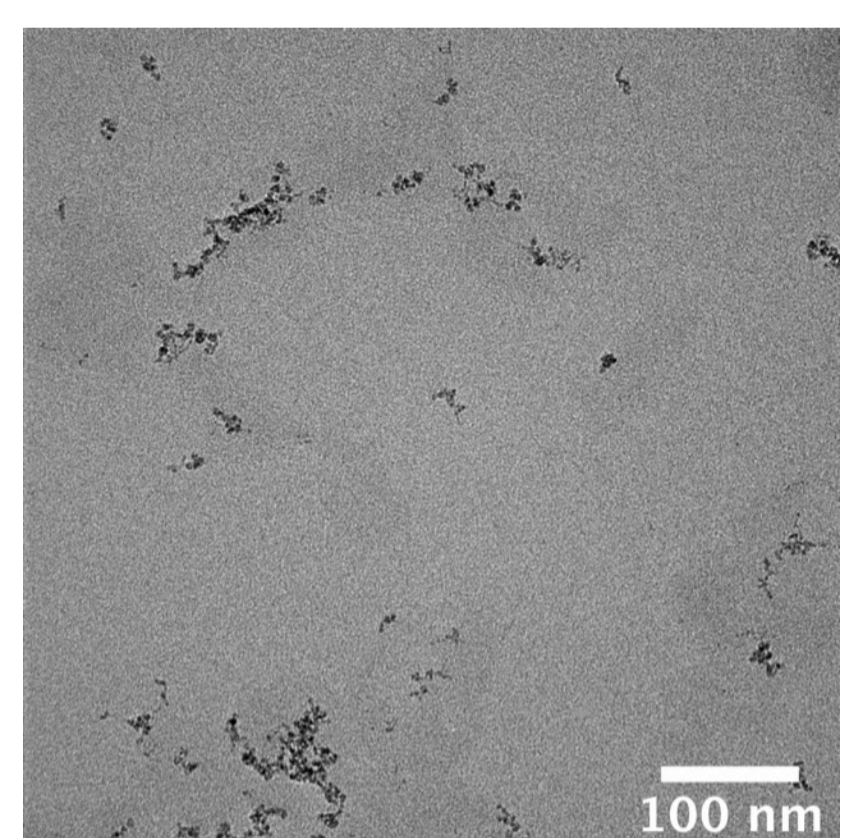
Magnetic anisotropy = better magnetic properties for MRI and hyperthermia



Co-precipitation of Fe(II) and Fe(III) salts in the presence of 10 kDa Dextran:

- 😊 Simple experimental procedure
- 😞 Large aggregates, polydispersity, difficult separation of aggregates of different sizes

Work in progress: synthesis optimization and exploration of **thermal decomposition** methods to obtain worm-like IO nanoparticles.



REFERENCES:

- (1) Moros, M. et al. *Nanoscale* **2010**, 2, 1746–1755. (2) Moros, M. et al. *ACS Nano* **2012**, 6, 1565–1577. (3) Wang, W. et al. *Langmuir* **2014**, 30, 6197–6028. (4) Fratila, R. M. et al. *Langmuir* **2014**, in press, DOI: 10.1021/la5015658. (5) Park, J. H. et al. *Small* **2009**, 5, 694–700.

ACKNOWLEDGEMENTS: