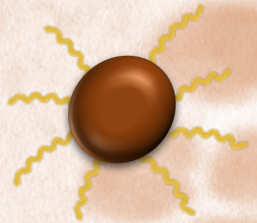
Polymeric magnetic microparticles as electrochemical immunosensing platforms

Celia Toyos-Rodríguez, Francisco Javier García-Alonso and Alfredo de la Escosura-Muñiz

NanoBioAnalysis Group-Department of Physical and Analytical Chemistry, University of Oviedo, Julián Clavería 8, 33006, Oviedo, Spain.

toyoscelia@uniovi.es



2-17 November 2020

IECB 2020

NBA NanoBioAnalysis Group
www.nba.grupos.uniovi.es

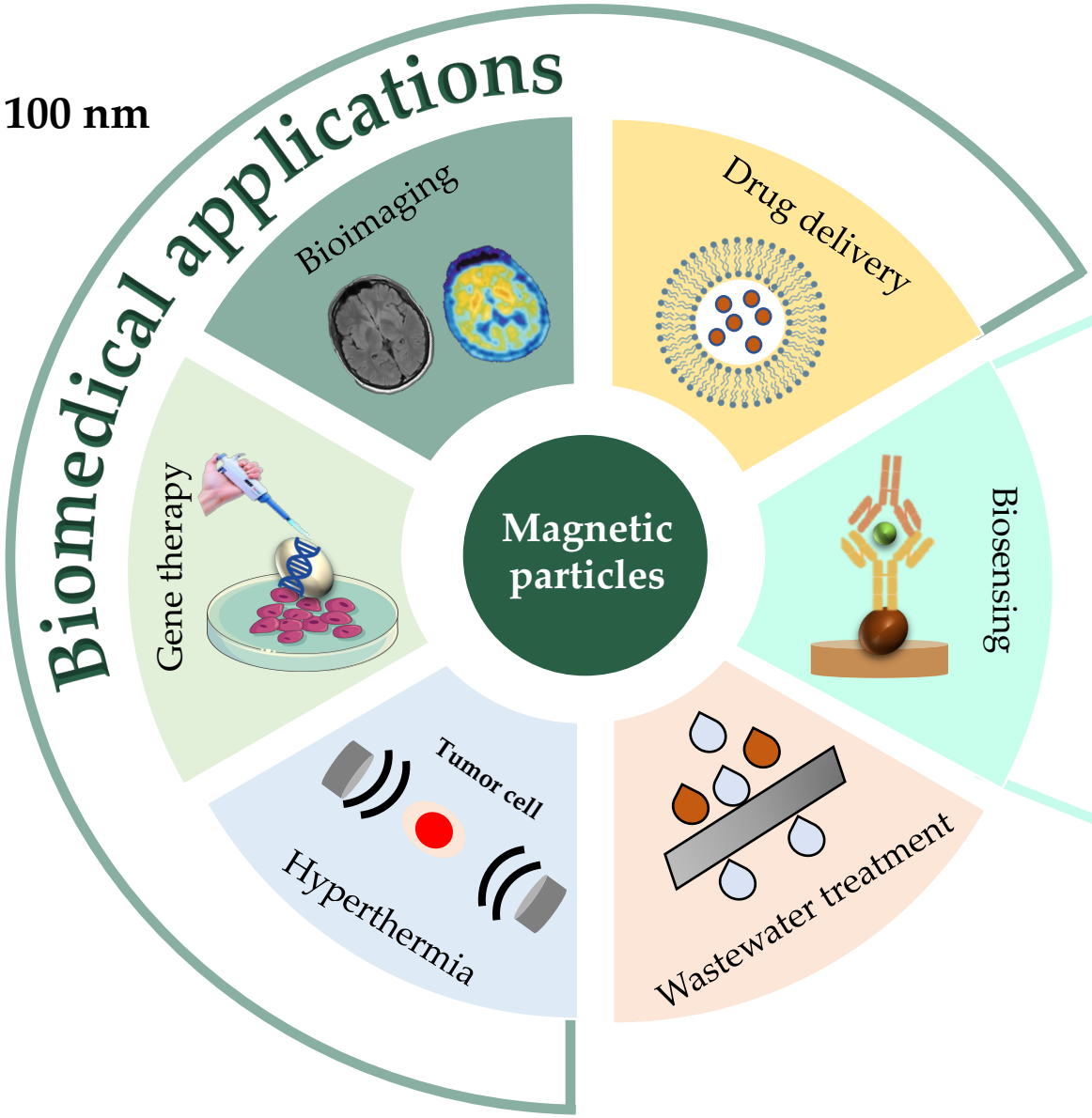
Universidad de Oviedo

Outlook

- Introduction
- Objectives
- Results and discussion
- Conclusions

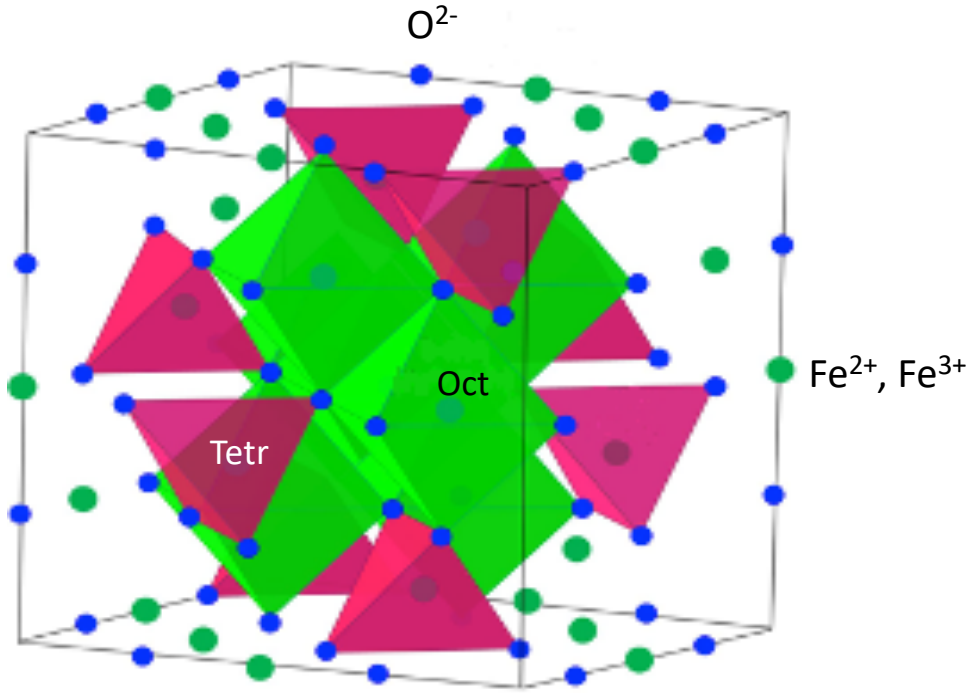
Polymeric magnetic microparticles as electrochemical immunosensing platforms

< 100 nm



- **Important properties:**
  - Size
  - Magnetic moment
  - Coercivity
  - Remanent magnetization
- **Magnetic microparticles (MMPs) are mainly used in biosensing.**

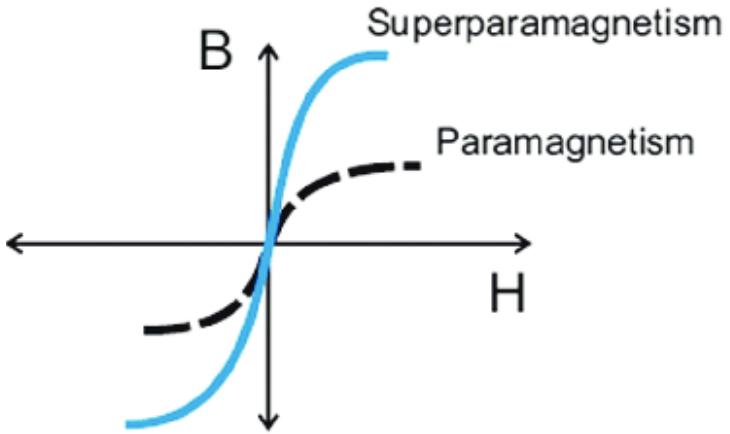
Magnetic nanoparticles (MNPs)

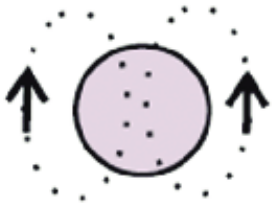


Magnetite (Fe_3O_4)

Sci Rep 9, 4464 (2019)

- Low toxicity
- Stability under extreme conditions
- Superparamagnetic behaviour <20 nm



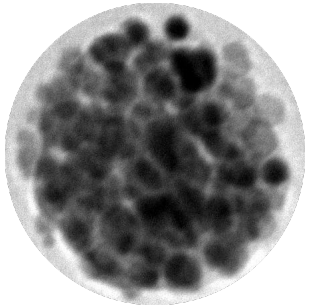


J. Colloid Sci. Biotechnol. 2014, Vol. 3, No. 1

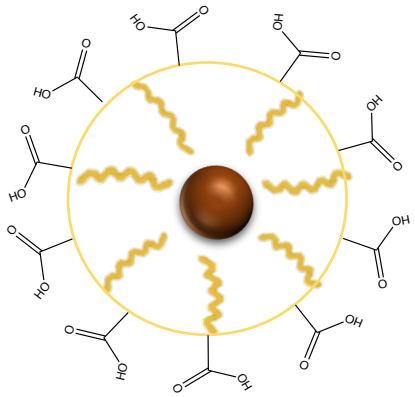
Magnetic microparticles (MMPs)

Colloidally assembled MMPs

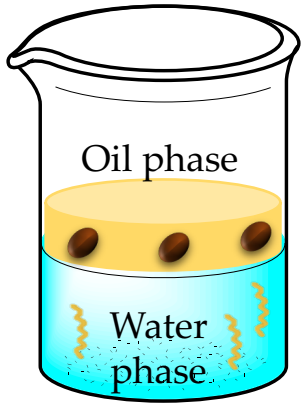
- High magnetic moment
- Superparamagnetic behaviour



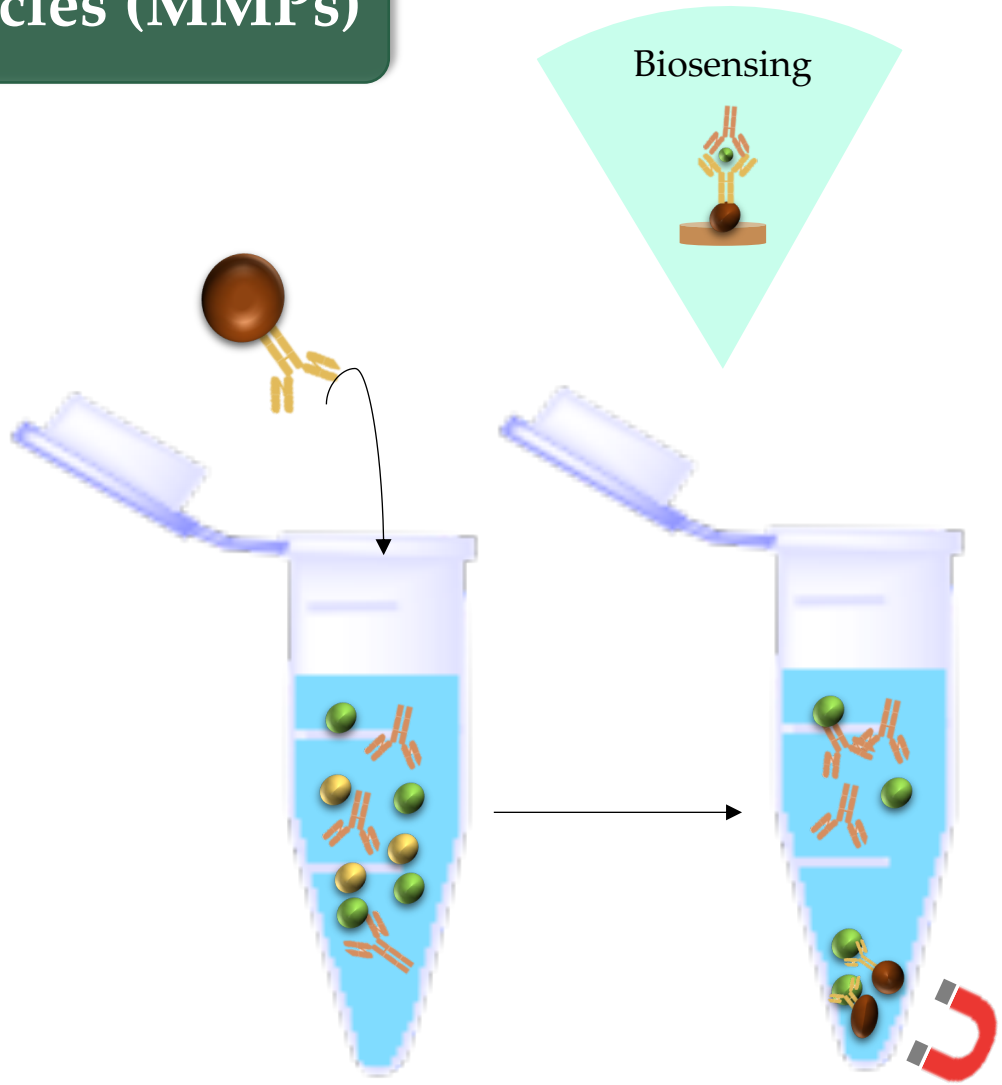
Solvothermal method



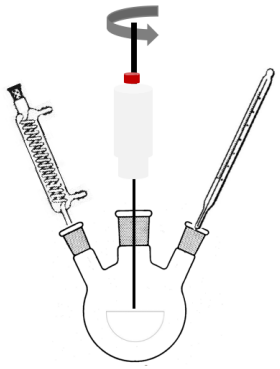
Amphiphilic polymer encapsulation

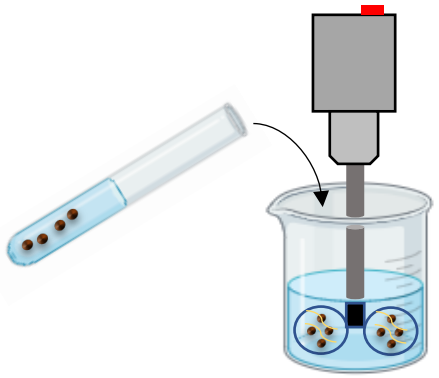


Emulsion-based assembly



Objectives





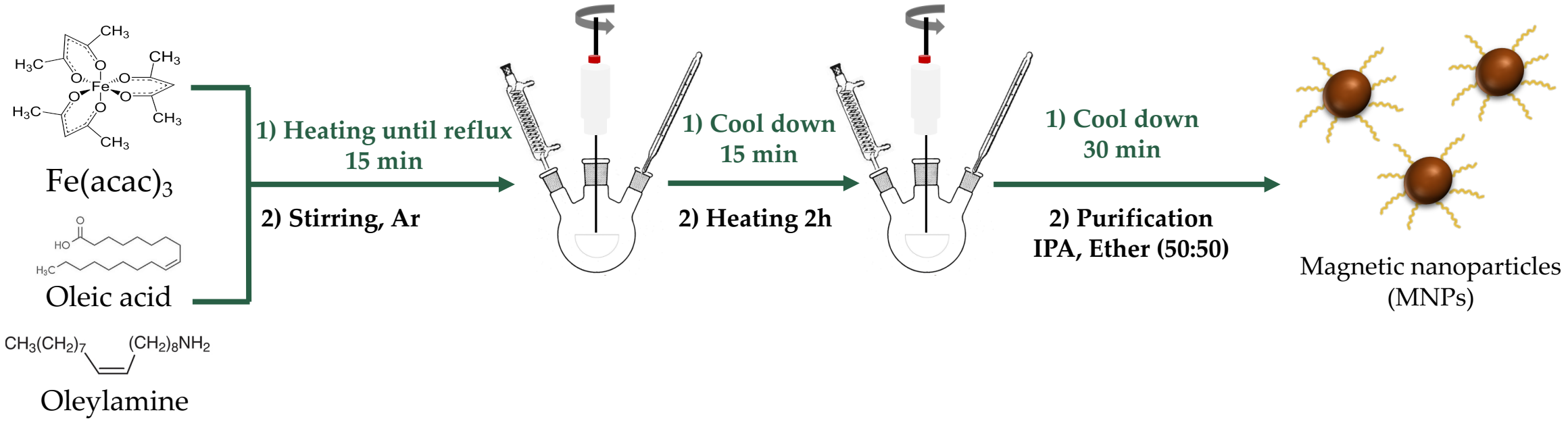
IMMUNOSENSING

1 Synthesis of MNPs

2 Encapsulation of MNPs into MMPs

1 Synthesis of MNPs

Thermal-decomposition method



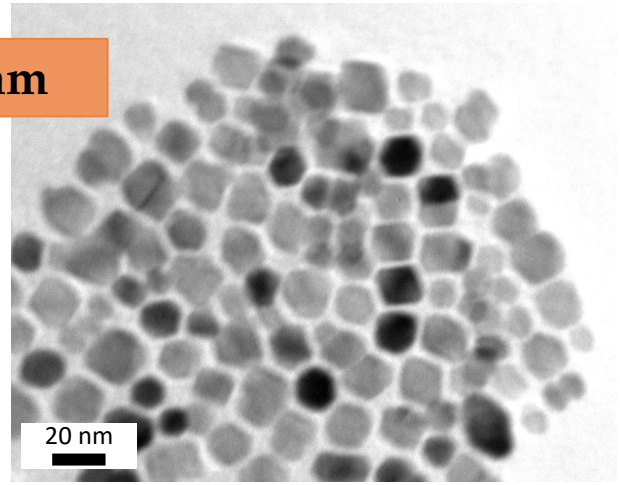
Toyos-Rodríguez C. et al. Journal of Nanomaterials 2019 (2019) 10

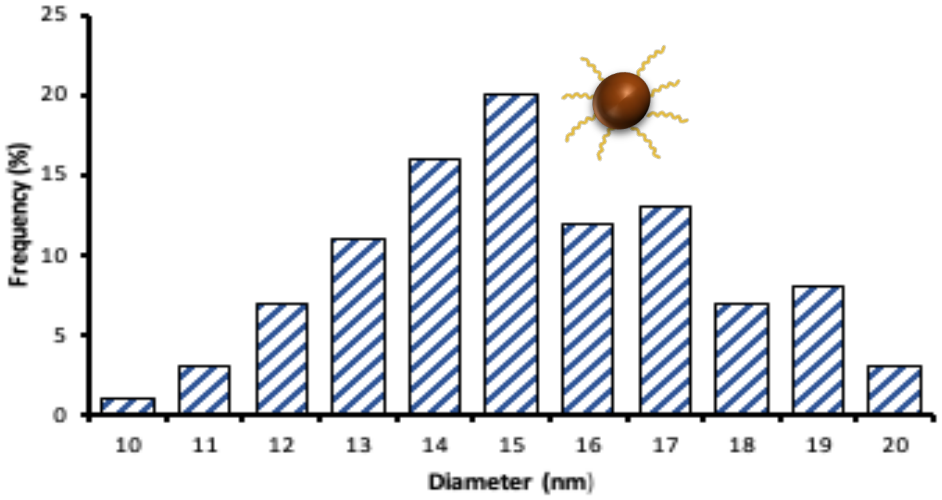
Polymeric magnetic microparticles as electrochemical immunosensing platforms

Size characterization

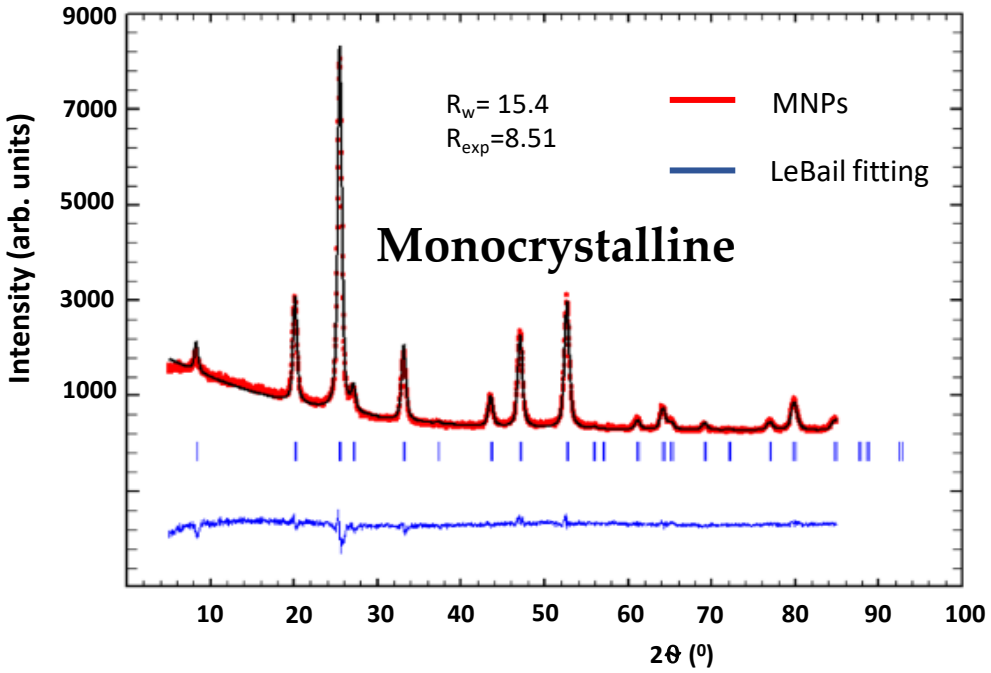
TEM

15 ± 5 nm





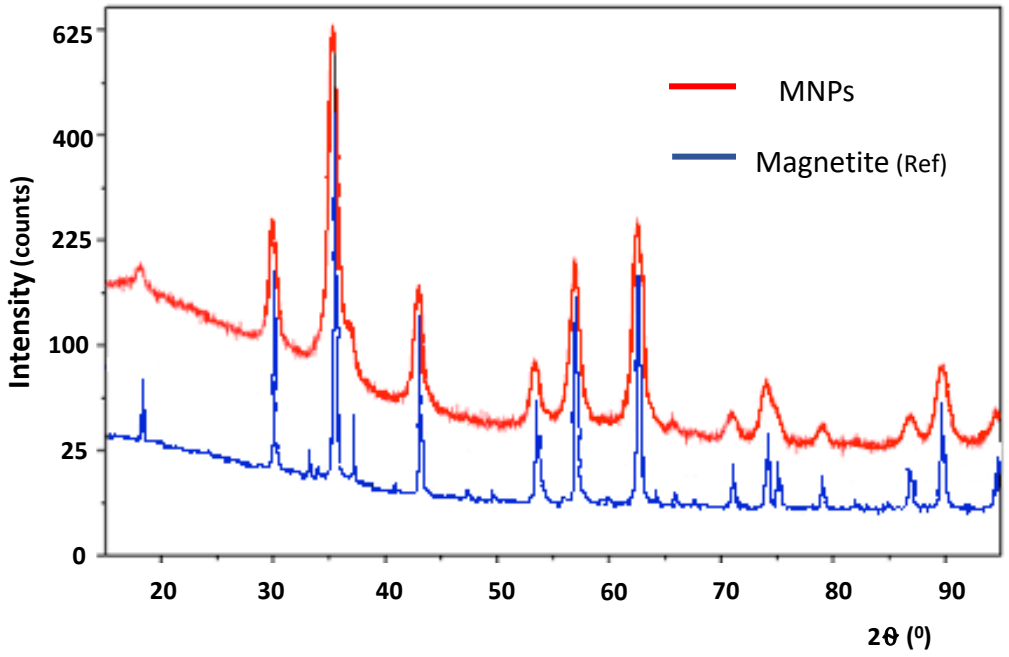
X-Ray diffraction



Crystal size 12 ± 2 nm

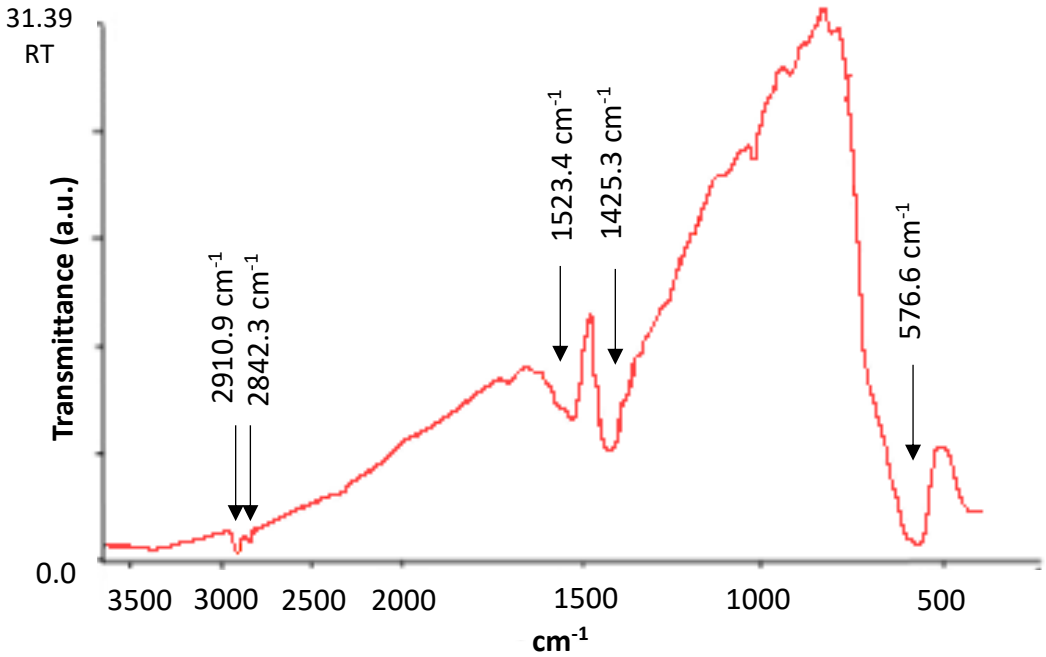
Structural characterization

X-Ray diffraction



Mainly composed of magnetite (Fe_3O_4)

IR

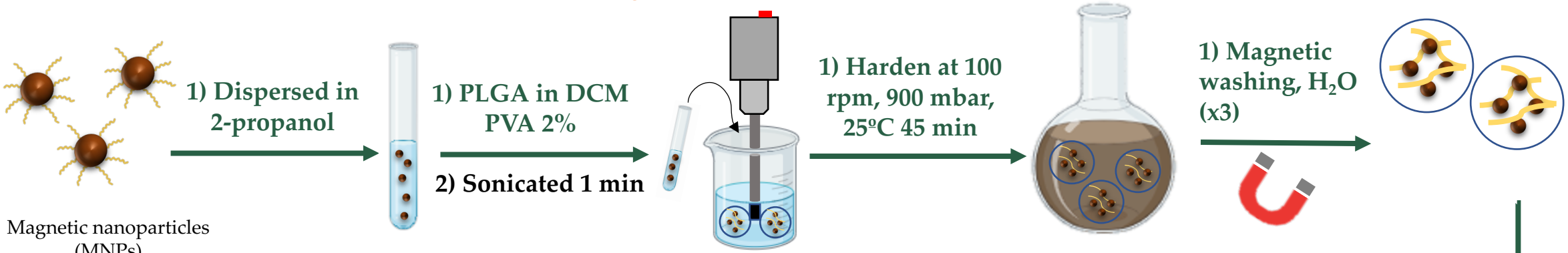


- 577 cm^{-1} magnetite solid-state vibrations
- 2911 cm^{-1},w, and 2842 cm^{-1}, w stretching of CH bonds
- 1523 cm^{-1}, w, br, and 1425 cm^{-1}, m, br antisymmetric and symmetric stretching of COOH and CH_2 deformation.

2 Encapsulation of MNPs into MMPs

Emulsion-based assembly

Synthesis



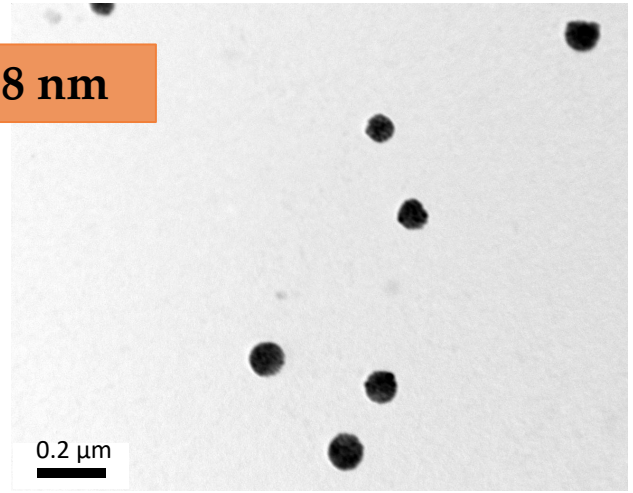
Functionalization

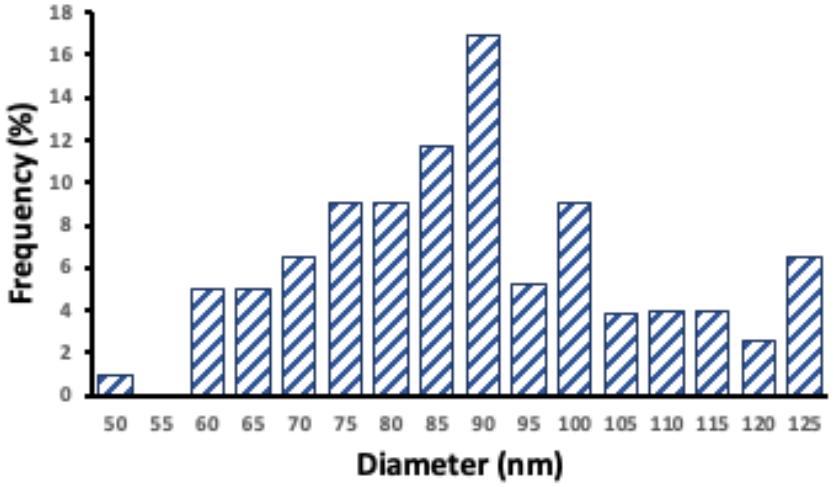
Polymeric magnetic microparticles as electrochemical immunosensing platforms

Size and structural characterization

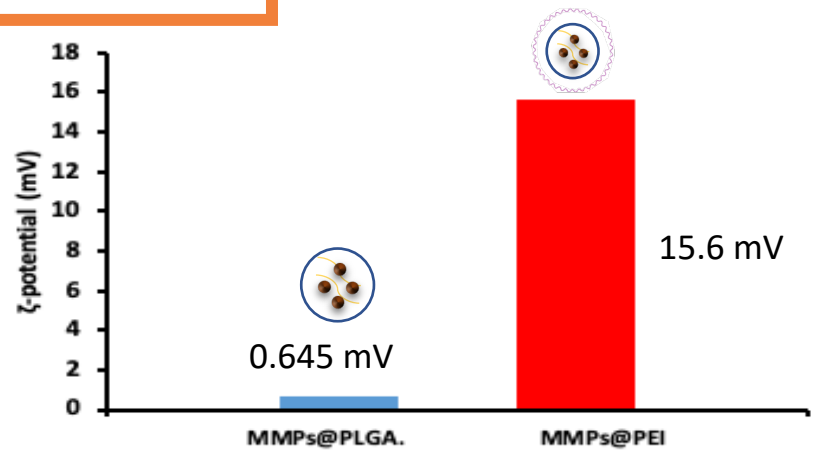
TEM

90 ± 18 nm

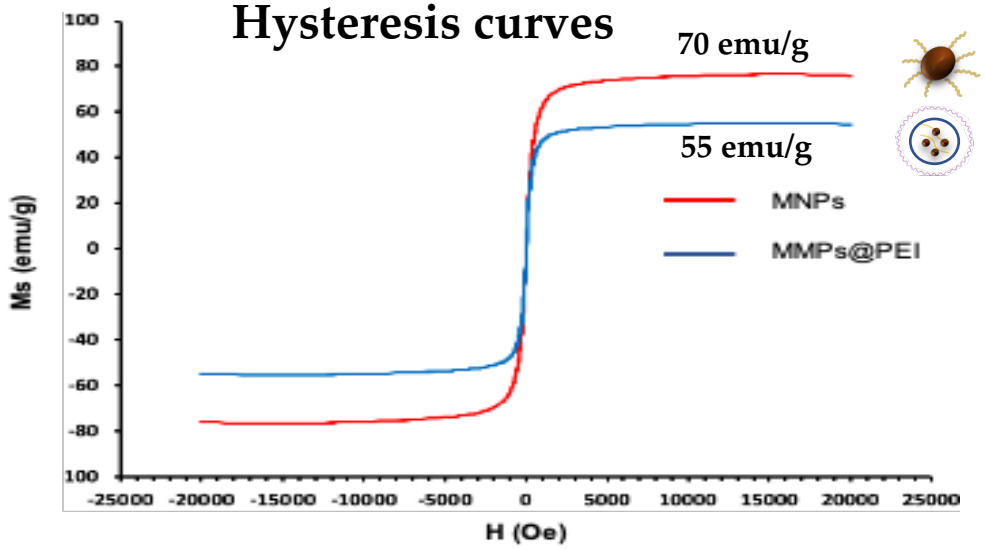




DLS



Hysteresis curves



Conclusions

1. Thermal-decomposition allowed the obtaining of MNPs of 15 ± 5 nm and an Ms of 70 emu/g.

2. MMP of 90 ± 18 nm with an Ms of 55 emu/g were obtained
   - MMPs could be conjugated with PEI

Further

Research

Suitable for further use as immunosensing platform

Acknowledgements

Celia
Toyos-Rodríguez

Francisco Javier
García-Alonso

Alfredo de la
Escosura-Muñiz

GOBIERNO DE ESPAÑA
MINISTERIO DE ECONOMÍA, INDUSTRIA Y COMPETITIVIDAD

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA E INNOVACIÓN

GOBIERNO DEL PRINCIPADO DE ASTURIAS

Universidad de Oviedo

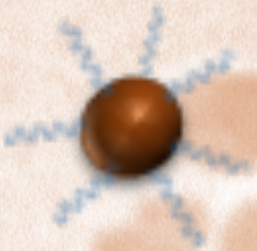
toyoscelia@uniovi.es
alfredo.escosura@uniov.es

Polymeric magnetic microparticles as electrochemical immunosensing platforms

Celia Toyos-Rodríguez, Francisco Javier García-Alonso and Alfredo de la Escosura-Muñiz

NanoBioAnalysis Group-Department of Physical and Analytical Chemistry, University of Oviedo, Julián Clavería 8, 33006, Oviedo, Spain.

toyoscelia@uniovi.es



2-17 November 2020

IECB 2020

NBA NanoBioAnalysis Group
www.nba.grupos.uniovi.es

Universidad de Oviedo