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Polydopamine-Based Nanoparticles as Versatile Platforms for Advanced Lateral Flow Diagnostics

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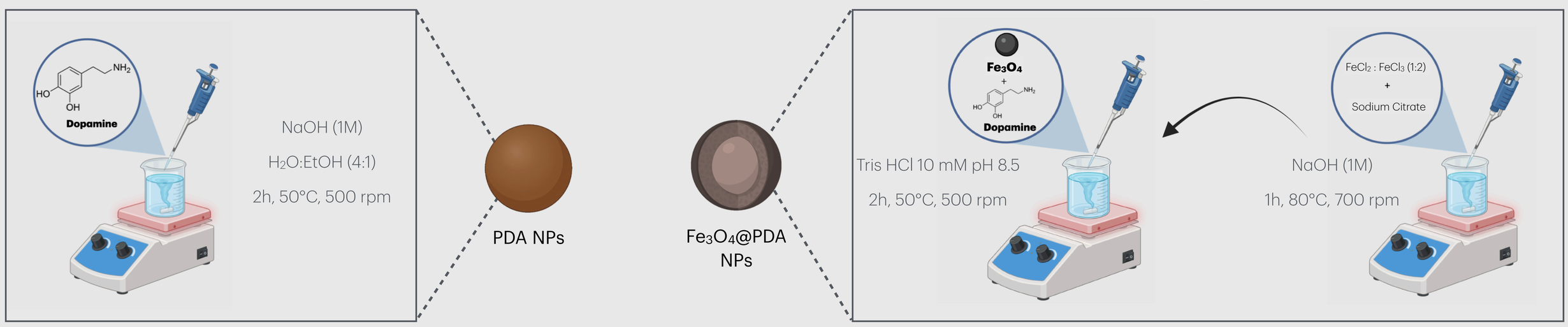
Background & Aim of the work

In recent years, Polydopamine (PDA) has been widely used in Lateral Flow Assays (LFAs) as a substitute for conventional gold nanoparticles (AuNPs). Thanks to its structural properties that mimic the adhesion proteins in mussels[1], PDA—unlike AuNPs, which rely on weak, non-specific passive adsorption or require complex heterobifunctional linkers—allows for direct covalent bioconjugation.[2,3] PDA, rich in quinone groups, reacts with antibodies via Michael addition or Schiff base formation.

Another property of PDA is its high absorption in the UV-VIS region, which allows for a high contrast on nitrocellulose.

In this work, we compare PDA and Fe_3O_4@PDA nanoparticles (NPs) for the detection of human transferrin via LFA, to determine whether the magnetic core enhances LFA performance in terms of visual contrast, signal intensity, and signal-to-noise ratio (SNR).

Synthesis



Results - Characterization

Dynamic Light Scattering (DLS)

	Z-average (nm)	PDI
PDA	115± 2	0,17± 0,02
PDA@Ab @Caseine	138± 1	0,12± 0,03

	Z-average (nm)	PDI
Fe_3O_4	85± 1	0,16± 0,02
Fe_3O_4@PDA	105± 2	0,15± 0,01
Fe_3O_4@PDA@Ab @Caseine	181± 1	0,15± 0,01

Transmission Electron Microscopy (TEM)

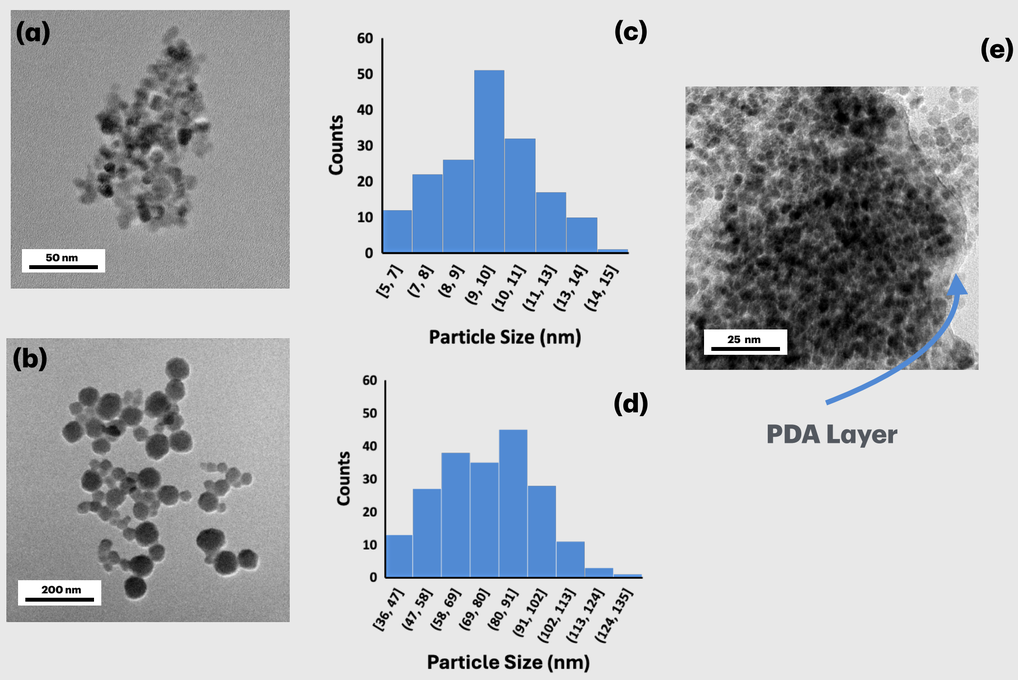


Fig. 1 TEM analysis of (a) Fe_3O_4 cores, (b) PDA NPs with relative size distributions (c, d). (e) Fe_3O_4@PDA clusters.

UV-Vis Spectroscopy

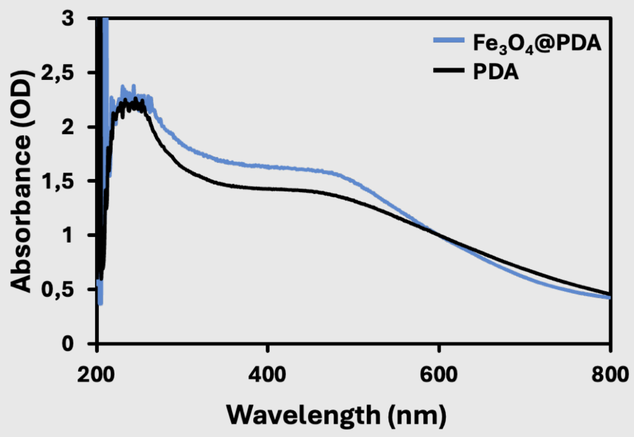
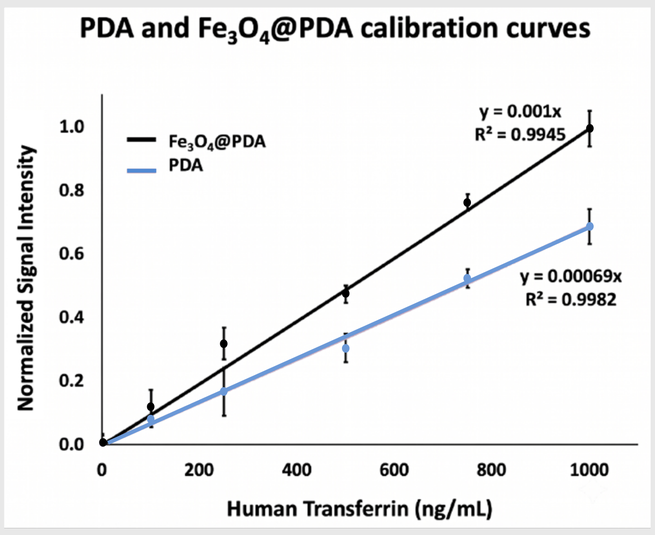
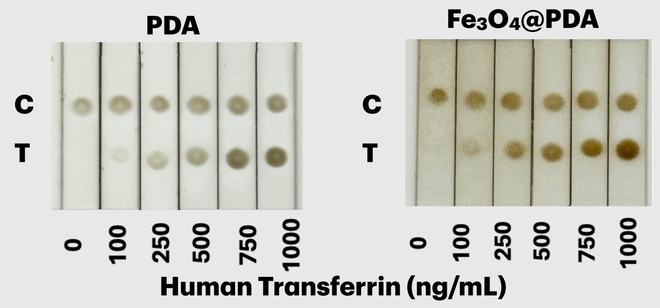


Fig. 2 UV-Vis spectra of PDA and Fe_3O_4@PDA at the same Optical Density (OD_{600nm} = 1)

Calibration Curve





Parameter	PDA	Fe_3O_4@PDA
LOD (ng/mL)	127	91
LOQ (ng/mL)	416	300
SNR (@500 ng/mL)	11	17

Acknowledgments

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References

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